Torres-Rojas, Genara

From: thindin@law111.com
Sent: Wednesday, August 26, 2015 11:49 AM
To: Olivencia, Mildred
Cc: Torres-Rojas, Genara; Van Duyne, Sheree; Ng, Danny
Subject: Freedom of Information Online Request Form

Information:

First Name: Trevor
Last Name: Hindin
Company: Berns Weiss LLP
Mailing Address 1: 20700 Ventura Blvd., Suite 140
Mailing Address 2:
City: Woodland Hills
State: CA
Zip Code: 91364
Email Address: thindin@law111.com
Phone: 818-961-2000
Required copies of the records: Yes

List of specific record(s):
1. A copy of the executed signed final contract for the Bayonne Bridge Navigational Clearance Program, between the Port Authority of New YorkNew Jersey, and Skanska Koch, Inc. and Kiewit Infrastructure Co., and any documents incorporated by reference therein. 2. Copies of all Applications for Payment, or other requests for payment, by Skanska Koch, Inc. andor Kiewit Infrastructure Co. for services rendered in 2013 and 2014 in connection with the Bayonne Bridge Navigational Clearance Program. 3. Copies of documents sufficient to reflect all payments made by the Port Authority of New YorkNew Jersey to Skanska Koch, Inc. andor Kiewit Infrastructure for services rendered in 2013 and 2014 in connection with the Bayonne Bridge Navigational Clearance Program.

THE PORT AUTHORITY OF NY & NJ

FOI Administrator

May 5, 2016

Mr. Andrew Lum
Berns Weiss LLP
6800 Owensmouth Avenue, Suite 310
Canoga Park, CA 91303

Re: Freedom of Information Reference No. 16278

Dear Mr. Lum:

This is in response to your August 26, 2015 request, which has been processed under the Port Authority's Freedom of Information Code (copy enclosed) for copies of records related to the following: 1. A copy of the executed signed final contract for the Bayonne Bridge Navigational Clearance Program, between The Port Authority of New York & New Jersey, and Skanska Koch, Inc. and Kiewit Infrastructure Co., and any documents incorporated by reference therein. 2. Copies of all Applications for Payment, or other requests for payment, by Skanska Koch, Inc. and/or Kiewit Infrastructure Co. for services rendered in 2013 and 2014 in connection with the Bayonne Bridge Navigational Clearance Program. 3. Copies of documents sufficient to reflect all payments made by The Port Authority of New York and New Jersey to Skanska Koch, Inc. and/or Kiewit Infrastructure for services rendered in 2013 and 2014 in connection with the Bayonne Bridge Navigational Clearance Program.

Material responsive to item 1 which is the remaining portion of your request and available under the Code can be found on the Port Authority's website at http://www.panynj.gov/corporate-information/foi/16278-C-2.pdf. Paper copies of the available records are available upon request.

Certain portions of the material responsive to your request are exempt from disclosure as, among other classifications, personal privacy and security.

Please refer to the above FOI reference number in any future correspondence relating to your request.

Very truly yours,

Danny Ng
FOI Administrator

Enclosure

4 World Trade Center, 18th Floor
150 Greenwich Street
New York, NY 10007
T: 212 435 3642 F: 212 435 7555

May 10, 2013

THE PORT AUTHORITY OF NY & NJ

Lillian D. Valenti
Director, Procurement

VIA FACSIMILE AND UPS NEXT DAY DELIVERY

Skanska Koch, Inc.
Kiewit Infrastructure Co. (JV)
400 Roosevelt Avenue
Carteret, NJ 07008

SUBJECT: BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES - CONTRACT AKB-264.039
PURCHASE ORDER UAKB264039

Gentlemen:

The Port Authority of New York and New Jersey hereby accepts your proposal on the above Contract.

The Port Authority elects not to require you to furnish a performance and payment bond.

Your attention is directed to the clause in the Contract entitled "Local Business Enterprises (LBE) Program and the Authority's long-standing practice of making available contract opportunities for Local Business Enterprises as noted in Section 11 of the Contract.

Additionally, please draw your attention to "Time for Completion and Damages for Delay" and to the fact that before you may commence performance of the work you must furnish whichever of the documents mentioned in that clause are applicable.

Forwarded herewith for your use and compliance are "General Instructions Relating to the Direction and Processing of Correspondence and of Those Other Items Specified to be Submitted to the Port Authority Under the Terms of the Contract".

In order to ensure that payments are processed properly, please include the above-referenced Purchase Order No. on all payment invoices and correspondence.

Very truly yours,

THE PORT AUTHORITY OF NEW YORK
AND NEW JERSEY

BY _____
Director of Procurement

Approved as to form:

Darrell Buchbinder
General Counsel

By _____
Attorney Timothy Strickland
Date 4/30/13

2 Montgomery Street, 3rd Floor
Jersey City, NJ 07302
T: 201 395 7477

Skanska Koch, Inc.
Kiewit Infrastructure Co.
(JV)

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THE PORT AUTHORITY OF NY & NJ

CB06264039
PQL

F.F.
J.S.
HDR/PB, A Joint Venture

BAYONNE BRIDGE

BAYONNE BRIDGE - REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

CONTRACT AKB-264.039

Volume 1 of 3

APRIL 2013

This proposal is not complete unless bidder's Signature appears on page 29

THE PORT AUTHORITY OF NY & NJ

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16859	ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)
16860	ELECTRIC HEATERS
16936	SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

Figure 1 Noise Sensitive Zones

Schedule of Minimum Wage Rates (FED NJ)
Schedule of Minimum Wage Rates (FED NY)
Notification of M/WBE On-line Directory and Forms
Schedule A
Schedule B
Schedule C
Schedule D
Analysis of Bid

INFORMATION FOR BIDDERS

1. FORM AND SUBMISSION OF PROPOSALS

The Port Authority of New York and New Jersey, hereinafter called "the Authority", invites Proposals in the annexed form. Proposals will be received until 2:30 P.M. on Friday, April 5, 2013 in the office of the Director of Procurement, Attn: Bid Custodian, Two Montgomery Street, 3rd Floor, Jersey City, NJ 07302 at which time they will be opened and publicly read in the Bid Room. Each Proposal must be contained in the envelope furnished by the Authority, which shall be sealed and conspicuously endorsed with the bidder's name and the number of this Contract in the space provided. This Contract booklet shall not be unstapled or taken apart.

The Proposal must be submitted upon the blank form bound herewith and must give all information required. [1] The Proposal must be signed and the acknowledgment taken on the appropriate form following the Proposal.

No effort is made to emphasize any particular provision of the Contract, but bidders must familiarize themselves with every provision and its effect.

2. PAPERS ACCOMPANYING PROPOSALS

Each Proposal must be accompanied by the following papers, which, unless otherwise indicated, should be enclosed with the Proposal:

A. If the bidder be a corporation, a statement of the names and residences of its officers, which should be included on the page following the Proposal.

If the bidder be a partnership, a statement of the names and residences of its members, indicating which are general and which are special partners, which should be included on the page following the Proposal.

If the bidder be an individual, a statement of his residence, which should be included on the page following the Proposal.

B. Either the Bid Bond bound herewith, duly executed by the bidder as principal and by one or more surety companies duly authorized to carry on the business of suretyship in the state(s) in which the construction site is located, whose names appear on the current list of the Treasury Department of the United States as acceptable as sureties upon federal contracts; or, in lieu of a Bid Bond;

A certified check, payable to the order of The Port Authority of New York and New Jersey, in the same amount appearing in the Bid Bond form, which check shall be placed in an envelope marked "Bid Security" and enclosed with the Proposal.

C.

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[1] While two or more copies of this booklet may be furnished to each prospective bidder, only one should be submitted. The extra copies are for the bidders use.

1.) Certified financial statements, including applicable notes, reflecting the bidder's assets, liabilities, net worth, revenues, expenses, profit or loss and cash flow for the most recent calendar year or the bidder's most recent fiscal year.

2.) Where such certified financial statements are not available, then either reviewed or compiled statements from an independent accountant setting forth the information described in Paragraph 1, above.

3.) Where neither certified financial statements nor financial statements from an independent accountant are available, then financial statements containing the information described in Paragraph 1, above, prepared directly by the bidder. However, such financial statements must be accompanied by a signed copy of the bidder's most recent Federal income tax return and a statement in writing, signed by a duly authorized representative of the bidder, that such statements accurately reflect the current financial condition of the bidder.

Where statements submitted pursuant to either Paragraph 1 or 2, above, show the position of the bidder as of a date more than forty-five (45) days prior to the date on which Proposals are opened, the bidder shall also submit a statement in writing signed by a duly authorized representative of the bidder, that the present financial condition of the bidder is at least as good as that shown on the statements submitted.

4.) A statement of work which the bidder has on hand, including any work on which a bid has been submitted, containing a description of the work, the dollar value, the location by city and state, the current percentage of completion and the expected date for completion.

5.) Fill in below the name and address of the bidder's chief banking representative handling the bidder's account.

Banking Institution:	Bank of America
Address:	600 Peachtree Street N.E., 9th Fl
	Atlanta, GA 30308
Bank Representative:	Towanda Toms
Telephone Number:	888-715-1000 ext 35481

6.) Fill in below the bidder's Federal Employer Identification Number (i.e., the number assigned to firms by the Federal Government for tax purposes); the bidder's Dun and Bradstreet number, if any; the name of any other credit service to which the bidder has furnished information and the number, if any, assigned by such service to the bidder's account.

TBD

Federal Employer Identification No.

TBD

Dun and Bradstreet No.

TBD

Other Credit Service

TBD

Account No.

D. The Form of Contract bound herewith, with the bidder's amounts inserted in the clauses thereof entitled "Contractor's Compensation" and "Unit Prices ". The amounts must be given both in figures and in writing and, in case of discrepancy, the writing shall control. The unit prices must be extended and totaled. In addition, bidders shall insert the same amounts in the clause of Information For Bidders entitled "Comparison of Proposals" and compute the "Total". One copy of each addendum, if any, issued during the bidding period shall be initialled and attached to the Proposal, but any Proposal submitted without such addendum initialled and attached will nevertheless be construed as though such addendum had been initialled and attached.

E. The bidder's analysis of bid filled in on the form furnished herewith. The Contractor will be required to furnish a more detailed analysis of bid at a later date in accordance with the requirements of the Section of Division 1 of the Specifications referring to the Analysis of Bid.

5.) Fill in below the name and address of the bidder's chief banking representative handling the bidder's account.

Banking Institution:	Bank of America
Address:	600 Peachtree Street N.E., 9th Fl
	Atlanta, GA 30308
Bank Representative:	Towanda Toms
Telephone Number:	888-715-1000 ext 35481

6.) Fill in below the bidder's Federal Employer Identification Number (i.e., the number assigned to firms by the Federal Government for tax purposes); the bidder's Dun and Bradstreet number, if any; the name of any other credit service to which the bidder has furnished information and the number, if any, assigned by such service to the bidder's account.

Federal Employer Identification No.
TBD

Dun and Bradstreet No.
TBD

Other Credit Service	TBD Account No.

D. The Form of Contract bound herewith, with the bidder's amounts inserted in the clauses thereof entitled "Contractor's Compensation" and "Unit Prices ". The amounts must be given both in figures and in writing and, in case of discrepancy, the writing shall control. The unit prices must be extended and totaled. In addition, bidders shall insert the same amounts in the clause of Information For Bidders entitled "Comparison of Proposals" and compute the "Total". One copy of each addendum, if any, issued during the bidding period shall be initialled and attached to the Proposal, but any Proposal submitted without such addendum initialled and attached will nevertheless be construed as though such addendum had been initialled and attached.

E. The bidder's analysis of bid filled in on the form furnished herewith. The Contractor will be required to furnish a more detailed analysis of bid at a later date in accordance with the requirements of the Section of Division 1 of the Specifications referring to the Analysis of Bid.

Contractors Compensation

PROCUREMENT (MAIL CENTER)
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3. COMPARISON OF PROPOSALS

Proposals will be compared on the basis of the total of the following amounts herein referred to as the "Total":

A. The amount equal to the Lump Sum for Unclassified Work inserted by the bidder in "B" of the clause entitled "Contractor's Compensation", plus.	A. $ 670,063,990.00[2]
B. An amount equal to the Estimated Total for Classified Work, plus	B. $ 26,216,370.00[2]
C. An amount[3] equal to the percentage inserted by the bidder in "C" of the clause entitled "Contractor's Compensation" times 42,000,000 12 % x 42,000,000, plus	C. $ 5,040,000.00
D. An amount equal[3] to 42,000,000	D. $42,000,000
Total	$ 743,320,360.00

Such "Total" shall be computed by adding the amounts in A, B, C and D above whether or not such amounts are correctly shown in the Contractor's Proposal.

Such "Total" is for the purpose of fixing the amounts of security to be maintained by the Contractor for the faithful performance of the Work. Prior to the signature of the Contract by the parties, it was for the purpose of facilitating the comparison of Proposals and of computing damages in the event of a default by the successful bidder in the agreement created by the acceptance of his Proposal.

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2 The bidder shall insert the same amounts inserted by the bidder in the clauses entitled "Contractor's Compensation" and "Unit Prices" and shall perform the computations to compute the "Total". In case of discrepancy between the amounts inserted by the bidder in the clauses entitled "Contractor's Compensation" and Unit Prices" and the amounts inserted herein, the amounts in the clauses entitled "Contractor's Compensation" and "Unit Prices" shall control. The amounts inserted by the bidder in the clauses entitled "Contractor's Compensation" and "Unit Prices" and amounts computed in accordance with such clauses will be used to determine the Contractor's Compensation.

3 Such amount is given solely as a basis for computation of the "Total". The Authority makes no representation as to what the actual amount will be and shall not be held responsible even though the amount is not even approximately correct. Insofar as the Contractor's Compensation is based upon Net Cost Work, it will be computed from the actual amount of Net Cost Work performed, as determined by the Engineer, whether greater or less than the amount.

4. QUALIFICATION INFORMATION

At any time after the opening of Proposals, the Chief Engineer may give oral or written notice to one or more bidders to attend a pre-award meeting and to furnish the Authority with information relating to his qualifications to perform the Work, including the following, which information shall be furnished within seven (7) days thereafter:

A. The bidders MBE/WBE Participation Plan submitted on the form annexed hereto as Schedule C (see the clause hereof entitled "Minority and Women's Business Enterprises Program") and a detailed list of the plant and equipment which the bidder proposes to use, indicating which portions it already possesses.

B. Detailed information relating to work which the bidder has completed for others, including personal and corporate references, sufficient to the Authority to determine the Contractor's responsibility, experience and capacity to perform the Work. If required by the Chief Engineer, the foregoing information shall include information to demonstrate to the satisfaction of the Chief Engineer that the Contractor has within the past five years been a contractor on at least one contract of the same general type, extent and complexity as the Contract on which the Proposal has been submitted, and completed the work *skillfully, in a satisfactory manner and on time.*

C. Information to supplement a) data shown in the financial statements and the statement of work on hand required to be submitted with the Proposal; and b) any statement submitted under the clauses hereof entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, etc, Disclosure of Other Required Information", "Certification of Participation in a State-Registered or United States Department of Labor-Registered Apprenticeship Program" or "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee".

D. Moreover, in the event that the bidder's performance on a past Port Authority or PATH contract or contracts has been rated less than satisfactory, the Chief Engineer may give oral or written notice to the bidder to furnish information demonstrating to the satisfaction of the Chief Engineer that, notwithstanding such rating, such performance was, in fact, satisfactory, or that the circumstances which gave rise to such unsatisfactory rating have changed or will not apply to performance of the Contract, and that such performance will be satisfactory.

E. If the bidder has performed a contract for the States of New York or New Jersey, or any governmental entity within such States and has filed a questionnaire or other document required to be submitted in order for the bidder to qualify to perform the contract, the bidder may be requested by the Chief Engineer to submit the most recent completed questionnaire or other such document, or if the most recent completed questionnaire or other such document is not available, to submit a written statement indicating the approximate date of the contract and the name of the governmental entity which awarded them the contract.

F. Any additional information relevant to the bidder's Proposal including information to supplement the bidder's initial analysis of bid.

G. Detailed information in writing setting forth the affirmative action which the bidder proposes to take to ensure equal employment opportunities as required by clause A of the clause of the Form of Contract entitled "No Discrimination in Employment". This action which for the purpose of convenience is referred to as an "Affirmative Action Program", shall be in addition to the action required under clauses B through G thereof. Solely for the information of the bidder and without in any way limiting or defining the affirmative action program to be proposed by the bidder, there are available for inspection in the office of the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, copies of sample affirmative action programs.

In the event that any of the foregoing is requested and is not furnished within seven days thereafter or within such additional time as the Chief Engineer, in his sole discretion, may allow, the Authority may not be in a position to determine whether the bidder is qualified, whether the bidder understands the requirements of the contract or whether the bid is responsive and may, in its sole discretion, reject the bidder's Proposal.

The giving of such notice to the bidder in connection with any of the foregoing lists, statement or information shall not be construed as an acceptance of his Proposal. However, the Authority reserves the right in its sole and absolute discretion, to accept the Proposal of a bidder despite the fact that said bidder has not submitted any information, list or statement required pursuant to this Section within the above-stated time period.

5. ACCEPTANCE OR REJECTION OF PROPOSAL

Within one hundred twenty (120) days after the opening of the Proposals, the Authority will accept one of the Proposals, if it accepts any. The acceptance of a Proposal will be only by mailing to or delivering at the office designated in the Proposal a notice in writing specifically indicating acceptance signed by an authorized representative on behalf of the Authority who is at present the Authority's Director of Procurement. No other act of the Authority, its Commissioners, officers, agents, or employees shall constitute acceptance of a Proposal. Such notice will state whether or not the Authority elects to require the bidder to furnish a Performance and Payment Bond. Rejection of a Proposal will be only by either (a) a notice in writing specifically stating that the Proposal is rejected, signed by an authorized representative on behalf of the Authority who is at present the Authority's Director of Procurement and mailed to or delivered at the office designated in the Proposal or (b) omission of the Authority to accept a Proposal within one hundred twenty (120) days after the opening of Proposals; and no other act of the Authority, its Commissioners, officers, agents or employees shall constitute rejection of a Proposal, including any counter offer or other act of the Authority, its Commissioners, officers, agents or employees.

The Authority reserves the unqualified right, in its sole and absolute discretion, to reject all Proposals or to accept that Proposal if any, which in its judgment will under all the circumstances best serve the public interest and to waive defects in any Proposal.

In the event that a successful bidder defaults upon the Contract by failing to furnish a satisfactory Performance and Payment Bond, if required, and the Authority terminates the Contract, the Authority reserves the option to accept the Proposal of any other bidder within one hundred twenty (120) days after the opening of Proposals, in which case such acceptance shall have the same effect as to such other bidder as though he were the originally successful bidder.

6. RETURN OF CERTIFIED CHECKS

Within ten (10) days after the opening of the Proposals the Authority will return all certified checks deposited by bidders, except those deposited by three bidders to be selected by the Authority, which will be returned within three days after one Proposal is accepted by the Authority; or if a Performance and Payment Bond is required, within three days after a satisfactory Performance and Payment Bond is furnished to the Authority; or if all Proposals are rejected, not later than three days after such rejection. The return of a bidder's check shall not, however, be deemed to be a rejection of his Proposal.

7. WEBSITE POSTINGS OF CONTRACT DOCUMENTS

Recipients of Contract documents marked Confidential (Privileged) may not post them or any of them to a website except in accordance with the Authority's prior written approval, which may require a written non-disclosure agreement.

Recipients of Contract documents not marked Confidential (Privileged) may not post them or any of them to a website unless the website (1) is non-public, (2) is password protected and (3) is accessible only to the recipient's prospective subcontractors and suppliers. Recipient's prospective subcontractors and suppliers shall also be deemed recipients and shall be required to conform to the terms of this numbered clause. Recipients shall be deemed to include both bidders and those who do not submit bids.

No later than 180 days after the date of receipt of Proposals, all recipients shall remove all Contract Documents from their websites.

8. DISPOSAL OF CONTRACT DOCUMENTS

All recipients of Contract documents, including bidders and those who do not bid and their prospective subcontractors and suppliers who may receive all or a part of the Contract documents or copies thereof, shall make every effort to ensure the secure and appropriate disposal of the Contract documents to prevent further disclosure of the information contained in the documents. Secure and appropriate disposal includes methods of document destruction such as shredding or arrangements with refuse handlers that ensure that third persons will not have access to the documents' contents either before, during, or after disposal. Documents may also be returned for disposal purposes to the Contract Desk on the 3rd Floor, 3 Gateway Center, Newark, NJ 07102 or the office of the Director of Procurement, Two Montgomery Street, 3rd Floor, Jersey City, NJ 07302.

9. AVAILABLE DOCUMENTS

Certain documents, specified below, are available for reference and examination by bidders by contacting Gary Greer at (973) 792-3934, 3 Gateway Center, 3rd Floor, Newark, NJ 07102 during regular business hours. These documents were not prepared for the purpose of providing information for bidders upon the present Contract but they were prepared for other purposes, such as for other contracts or for design purposes for this or other contracts, and they do not form a part of this Contract. The Authority makes no representation or guarantee as to, and shall not be responsible for their accuracy, completeness or pertinence, and, in addition, shall not be responsible for the conclusions to be drawn therefrom. They are made available to the bidders merely for the purpose of providing them with such information as is in the possession of the Authority, whether or not such information may be accurate, complete or pertinent or of any value to the bidders. Questions concerning the content of the documents shall be submitted in accordance with the clause entitled "Questions By Bidders".

Said documents are as follows:

1.* Drawings bearing the general title "The Port Authority of NY & NJ – Bayonne Bridge – Navigational Clearance Program" and which are separately numbered and entitled as follows:

Drawing No.	Title
BB–SL–027	Navigational Clearance Program – Project Site Map, General Notes, Legend, Abbreviations & Symbols, Soil Classifications
BB–SL–028	Navigational Clearance Program – Boring Location Plan – Staten Island, New York
BB–SL–029	Navigational Clearance Program – Boring Location Plan – Bayonne, New Jersey
BB–SL–030	Navigational Clearance Program – Presentation of Borings
BB–SL–031	Navigational Clearance Program – Presentation of Borings
BB–SL–032	Navigational Clearance Program – Presentation of Borings
BB–SL–033	Navigational Clearance Program – Presentation of Borings
BB–SL–034	Navigational Clearance Program – Presentation of Borings
BB–SL–035	Navigational Clearance Program – Presentation of Borings
BB–SL–036	Navigational Clearance Program – Presentation of Borings
BB–SL–037	Navigational Clearance Program – Presentation of Borings
BB–SL–038	Navigational Clearance Program – Presentation of Borings
BB–SL–039	Navigational Clearance Program – Presentation of Borings
BB–SL–040	Navigational Clearance Program – Presentation of Borings
BB–SL–041	Navigational Clearance Program – Presentation of Borings
BB–SL–042	Navigational Clearance Program – Presentation of Borings
BB–SL–043	Navigational Clearance Program – Presentation of Borings
BB–SL–044	Navigational Clearance Program – Presentation of Borings
BB–SL–045	Navigational Clearance Program – Presentation of Borings
BB–SL–046	Navigational Clearance Program – Presentation of Borings
BB–SL–047	Navigational Clearance Program – Presentation of Borings
BB–SL–048	Navigational Clearance Program – Presentation of Borings

2.* A document bearing the title "Bayonne Bridge Navigational Clearance Program (BBNCP) Replacement of Main Span Roadway And Approach Structures Final Geotechnical Subsurface Investigation Report – Volume I: Summary of Results" dated November 19, 2012, and consisting of 54 pages.

3.* A document bearing the title "Bayonne Bridge Navigational Clearance Program (BBNCP) Replacement of Main Span Roadway And Approach Structures Final Geotechnical Subsurface Investigation Report – Volume II: Appendix 5.2 – Test Data" dated November 19, 2012, and consisting of 1,177 pages.

4.* A document bearing the title "Bayonne Bridge Navigational Clearance Program (BBNCP) Replacement of Main Span Roadway And Approach Structures Final Geotechnical Subsurface Investigation Report – Volume III: Appendix 5.3 – Cross Hole Seismic Testing Report" dated November 19, 2012, and consisting of 80 pages.

5. Inspection Report by Boswell Engineering (PANYNJ – Materials Engineering Division Contract NO. 426-12-012).

6. Remedial Action Workplan, Bayonne Bridge, New Jersey prepared by Arcadis dated April 2012

7. Contract Documents for AKB-264.054, Bayonne Bridge Design and Construction of Resident Engineer's Office.

8. Contract Documents for AKB-173, Bayonne Bridge Lead Abatement and Repainting of Main Span Arch via Work Order

9. Contract Documents for AK-150.003, "The Port of New York Authority – Bayonne Bridge – Staten Island Plaza Improvements" dated November 16, 1966, and consisting of 51 pages.

10. Phase 1 Environmental Site Assessment for Port Authority Owned Properties prepared by Hatch Mott MacDonald.

11. Environmental Screening for Non-Port Authority Owned Properties prepared by Hatch Mott MacDonald.

12. Contract Documents for AK-155 "The Port Authority of NY & NJ – Staten Island Bridges – Rehabilitation of Bridge Lighting Systems, CCTV Feeders and Miscellaneous Structures," dated 6/22/01.

13. Contract Documents for AKB-137 "The Port Authority of NY & NJ – Bayonne Bridge – Administration Building Reroofing," dated May 11, 1993.

14. Contract Documents for AK-190A "The Port Authority of NY & NJ – Staten Island Bridges – Replacement of Hazmat & Supply Storage Buildings," dated 4-20-2012.

15. Contract Documents for AK-150.010 "The Port Authority of NY & NJ – Staten Island Plaza Improvements – Toll's Building," dated Feb 13, 1964.

16. "Asbestos- and Lead-Containing Materials and Hazardous Materials Report Bayonne Bridge Replacement of Main Span Roadway and Approach Structures," Agreement No: 415-11-301, Prepared By: Environmental Compliance, Inc.

17. "Construction Protection Plan for Bayonne Bridge Navigational Clearance Program," prepared for the New Jersey Historic Preservation Office and the New York State Office of Parks, Recreation and Historic Preservation, by Hartgen Archaeological Associates.

18. "Unanticipated Discoveries Plan for the Bayonne Bridge Navigational Clearance Program," by Hartgen Archaeological Associates.

19. Contract Documents for AKB-150 "The Port Authority of NY & NJ – Bayonne *Bridge – Roadway Temperature and Weather Information System," dated* 11/20/96.

20. Utility Survey, Borough Of Staten Island Richmond County New York And City Of Bayonne Hudson County.

21. Contract Documents for AKB-264.035 "Bayonne Bridge Rehabilitation of New Jersey Abutment" 12/19/1963

22. Contract Documents for AKB-264.018 "Main Span Structural Improvements," 10/4/2000

23. Confidential Contract Documents for MF-100.507 "Bayonne Bridge Arch Protection at Roadway,"2/7/2007

24. Confidential Contract Documents for MF-100.509C "Bayonne Bridge NJ Arch Abutment Improvement," 4/8/2008

25. Horizontal Tendons Shop Drawings, Submittal 03412-001 for AKB-264.035 "Bayonne Bridge Rehabilitation of New Jersey Abutment" 4/5/2004

26. Rock Anchor Drawings, for AKB-264.035 Bayonne Bridge Rehabilitation of New Jersey Abutment 11-03-04

27. The Port Authority of NY & NJ Boring Inspection Manual

28. LARSA MODEL INPUT FILES.zip which includes the following files:

    BAYONNE LL PATTERNS.DML

    EXISTARCH SHOP.LPSX

    EXISTARCH.LPSX

    EXISTFIOOR.LPSX

    EXISTLWRCHORDS.LPSX

    NEWFB_EDGEGIR.LPSX

    NEWMEMBERS.LPSX

    R9-TOWER_SECTIONS.LPSX

    R9_DEAD_LOAD.LAR

    R9_LOADS_EOASTAGE4.LAR

* NOTE: For the Bidder's convenience, these documents will be transmitted with the Contract Drawings.

10. MINORITY AND WOMEN'S BUSINESS ENTERPRISES PROGRAM (MBE/WBE)

The Authority has a long-standing practice of making its contract opportunities available to as many firms as possible and has taken affirmative steps to encourage Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs) to seek business opportunities with it.

"Minority-owned business" or "MBE" means a business entity which is at least 51 percent owned by one or more members of one or more minority groups, or, in the case of a publicly held corporation, at least 51 percent of the stock of which is owned by one or more members of one or more minority groups, and whose management and daily business operations are controlled by one or more such individuals who are citizens or permanent resident aliens.

"Women-owned business" or "WBE" means a business which is at least 51 percent owned by one or more women, or, in the case of a publicly held corporation, 51 percent of the stock of which is owned by one or more women, and whose management and daily business operations are controlled by one or more women who are citizens or permanent resident aliens.

"Minority group" means any of the following racial or ethnic groups:

A. Black persons having origins in any of the black African racial groups not of Hispanic origin;

B. Hispanic persons of Puerto Rican, Mexican, Dominican, Cuban, Central, or South American culture or origin, regardless of race;

C. Asian and Pacific Islander persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent or the Pacific Islands;

D. Native American or Alaskan native persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification.

To ensure meaningful participation of MBEs and WBEs on this Contract, the Authority has set a combined goal of 10 percent for firms owned and controlled by minorities and firms owned and controlled by women.

In the event that any portion of the Work is subcontracted in accordance with the clause of the Form of Contract entitled "Assignments and Subcontracts", every good faith effort to meet the above goals for MBE and WBE participation in the Work shall be made and documented. Such good faith efforts shall include at least the following:

A. Attendance at pre-bid meetings, if any, scheduled by the Authority;

B. Utilization of the Authority's Directory of certified MBE/WBEs available on-line (see Notification of M/WBE On-line Directory and Forms in back of Contract booklet) and/or proposing for certification other MBE/WBEs which appear to meet the Authority's criteria for MBE/WBE certification and which are technically competent to perform the Work which the bidder plans to subcontract;

C. Active and affirmative solicitation of bids for subcontracts from MBE/WBEs;

D. Advertisement in general circulation media, trade association publications and minority-focused media for a reasonable period before bids or proposals are due;

E. Dividing the work to be subcontracted into smaller portions or encouraging the formation of joint ventures, partnerships or similar arrangements among subcontractorsin order to increase the likelihood of achieving the MBE/WBE goals;

F. Providing a sufficient supply of drawings and specifications of prospective work to MBE/WBEs and providing appropriate materials to each in sufficient time to review; and

G. Utilizing the services of available minority and women's community organizations; contractors' groups; local, State and Federal business assistance/development offices and other organizations that provide assistance to MBE/WBEs.

Subsequent to acceptance by the Authority of the Contractor's Proposal, the Contractor shall use and document every good faith effort to comply with his MBE/WBE Participation Plan and to permit his MBE/WBE subcontractors to perform. Participation percentages shall be monitored throughout the performance of this Contract. Such good faith efforts shall include at least the following:

A. Ensuring that progress payments are made in a timely fashion in accordance with the requirements of this Contract;

B. Not requiring bonds from and/or providing bonds and insurance for subcontractors where appropriate;

C. Soliciting specific recommendations on methods for enhancing MBE/WBE participation from Authority staff responsible for such participation; and

D. Nominating subcontractors for participation in business assistance programs sponsored by the Authority or the Regional Alliance of Small Contractors such as the Loaned Executive Assistance Program (L.E.A.P.).

Subsequent to acceptance by the Authority of the Contractor's Proposal, the Contractor shall also provide the Engineer, at his request, with a trade breakdown schedule showing when the Contractor's MBE/WBE subcontractors are scheduled to perform. The Contractor shall also submit to the Engineer, on a monthly basis, the Statement of Subcontractor's Payments annexed hereto as Schedule D.

In the event that, prior to acceptance by the Authority of the Contractor's Proposal and following review of the MBE/WBE Participation Plan submitted by the bidder pursuant to the clause hereof entitled "*Qualification Information*", the Chief Engineer determines that the bidder has not made a good faith effort to meet the MBE/WBE participation goals set forth above and that the bidder has not demonstrated that a full or partial waiver of such goals is appropriate, the Chief Engineer may advise the bidder that it is not responsible and may reject the bidder's Proposal.

If, during the performance of the Contract, the Contractor fails to demonstrate good faith in carrying out his MBE/WBE Participation Plan and in permitting his MBE/WBE subcontractors to perform and the Contractor has not demonstrated that a full or partial waiver of the above referenced MBE/WBE participation goals is appropriate, then, upon receipt of a future proposal or proposals from the Contractor, the Chief Engineer may advise the Contractor that he is not a responsible bidder and may reject such proposal(s).

Either prior or subsequent to acceptance of the bidder's Proposal, the bidder may request a full or partial waiver of the above described MBE/WBE participation goals by providing a reasonable demonstration to the Chief Engineer that his good faith efforts will not result in compliance with the goals set forth above because participation by eligible MBE/WBEs could not be obtained at a reasonable price or that such MBE/WBEs were not available or refused to perform as subcontractors. The bidder shall provide such documentation to support his request as the Chief Engineer may require.

Once approved, the MBE/WBE Participation Plan submitted by the bidder may be modified only with the written approval of the Engineer.

Following approval by the Engineer under the clause entitled "Assignments and Subcontracts" of one or more subcontractors who are either MBEs or WBEs and listed in the MBE/WBE Directory or determined to be "eligible" by the Chief Engineer in accordance with this numbered clause, the Authority may, at its sole option, provide to said approved M/WBEs, without charge, whatever appropriate consultant services may be available under the L.E.A.P. Program; provided, however, that such consultant services will only be furnished pursuant to a request in writing from the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, 233 Park Avenue South - 4th Floor, New York, NY 10003.

Such services will be discontinued following a written request from the Contractor to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, to discontinue them.

The L.E.A.P. services include advising on scheduling, purchasing, planning and other aspects of construction to firms to mitigate business or management problems which could negatively impact on their performance. These services do not include engineering or legal advice. The determination as to whether or not to follow the advice given lies solely with the M/WBE subcontractor. Prior to being accepted as a participant in the L.E.A.P. Program, the M/WBE subcontractor will be required to release the Authority and the individuals furnishing consultant advice of all liability and responsibility in connection therewith.

The Authority has compiled and made available on-line an MBE/WBE Directory which specifies the firms the Authority has determined to be (1) MBEs/WBEs and (2) experienced in performing work in the trades and contract dollar ranges indicated in the Directory. The Authority makes no representation as to the financial responsibility of such firms or their ability to perform Work required under this Contract. Subject to the following paragraph, only MBEs/WBEs listed in the Directory will count toward the required MBE/WBE participation.

If the Contractor wishes to perform a portion of the Work through a firm not listed in the Directory [4] but which the Contractor believes should be eligible because it is (1) an MBE/WBE, as defined above and (2) technically competent to perform portions of the Work or the Contractor believes it is such a firm, the Contractor shall submit to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, a written request for a determination that the proposed firm is eligible. This shall be done by completing and forwarding a) the form labeled "Schedule A" and, if appropriate, "Schedule B" which are annexed hereto and form a part hereof and b) technical references of jobs completed of similar scope and complexity on the form annexed hereto and made a part hereof labeled "MBE/WBE Approval Request" and such other information as may be necessary to permit the Authority to determine whether the firm is in fact an MBE/WBE and technically competent to perform portions of the Work.

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[4] The following organizations may be able to refer the Contractor to MBEs/WBEs who are technically competent to perform portions of the Work. Any referrals which are not listed in the Directory shall be submitted to the Authority for a determination as to eligibility as provided above.

1. Queens Air Services Development Office
JFK International Airport
Building #141
Federal Circle, First Floor
Jamaica, NY 11430
(718) 244-6852
Fax (718) 244-7371
www.asdoonline.com

2. Chinatown Manpower Project, Inc.
70 Mulberry Street
New York, NY 10031
(212) 571-1690
www.cmpny.org

3. Association of Minority Enterprises of NY, Inc.
135-20 Liberty Avenue
Richmond Hill, NY 11419
(718) 291-1641
Fax (718) 291-1641
www.ameny.org

4. Statewide Hispanic Chamber of Commerce of New Jersey
150 Warren Street, Suite 110
Jersey City, NJ 07302
(201) 451-9512
Fax (201) 451-9547
www.shccnj.org

5. Greater Newark Business Development Consortium
744 Broad Street, 26th Floor
Newark, NJ 07102
(973) 242-5563
www.gnbdc.org

6. Jamaica Business Resource Center
90-33 160th Street
Jamaica, NY 11432
(718) 206-2255
Fax (718) 206-3693
www.jbrc.org

7. *Council for Airport Opportunity*
Newark Liberty International Airport
Building 80
Newark, NJ 07014
(973) 961-4382
www.caonj.com

8. *National Hispanic Business Group*
1230 Avenue of the Americas,
7th Floor
New York, NY 10020
(212) 265-2664
www.nhbg.org

9. Greater Jamaica Development Corp.
90-04 161st Street
Jamaica, NY 11432
(718) 291-0282
Fax (718) 291-7918
www.gjdc.org

10. NYS Assn. Of Minority Contractors
Brooklyn Navy Yard
Building 280, 4th Floor, Suite 414
Brooklyn, NY 11205
(212) 246-8380
Fax (718) 246-8376
www.nysamc.org

11. Professional Women in Construction
315 E. 56th Street, Suite 202
New York, NY 10022
(212) 486-7745
Fax (212) 486-0228
www.pwcusa.org

12. NY/NJ Minority Purchasing Council
330 Seventh Avenue, 8th Floor
New York, NY 10001
(212) 502-5663
www.nynjmsdc.org

13. National Minority Business Council
120 Broadway, 19th Floor
New York, NY 10271
(212) 693-5050
www.nmbc.org

14. Queens Overall Economic Development Office
120-55 Queens Boulevard, Suite 309 Kew Gardens, NY 11424
(718) 263-0546
Fax (718) 263-0594
www.queensny.org

15. York College Small Business Development Center
94-50 159th Street
York College,
Room S 107
Jamaica, NY 11451
(718) 262-2880
Fax (718) 262-2881
www.nyssbdc.org

16. Small Business Development Center - Rutgers University, University Heights
43 Bleeker Street
Newark, NJ 07102
(973) 353-1927
Fax (973) 353-1110
www.msbdc.newark.rutgers.edu

17. New Jersey Association of Women Business Owners (NJAWBO)
186 Princeton Hightstown Road
West Windsor, NJ 08550
(609) 799-5101
www.njawbo.org

18. New Jersey Air Services Development Office
Newark Liberty International Airport Building #80 - Second Floor
Newark, NJ 07114
(973) 961-4278
Fax (973) 961-4282
www.asdonline.com

19. Caribbean-American Chamber of Commerce
Brooklyn Navy Yard
63 Flushing Avenue
Brooklyn, NY 11205
(718) 834-4544
Fax (718) 834-9774
www.caribbeantradecenter.com

20. Northeast Region – Small Business Resource Transportation Center
29-10 Thomson Avenue
Long Island City, NY 11101
(718) 482-5941
www.osdbu.dot.gov/regional/northeast.cfm

21. Asian Women in Business
42 Broadway, Suite 1748
New York, NY 10004
(212) 868-1368
Fax (212) 868-1373
www.awib.org

22. Asian American Business Development Center
80 Wall Street, Suite 418
New York, NY 10005
(212) 966-0100
Fax (212) 966-2786
www.aabdc.com

23. New York State Federation of Hispanic Chambers of Commerce
2710 Broadway
New York, NY 10025
(212) 222-8300
Fax (212) 222-8412
www.nysfhcc.com

24. Orange County Chamber of Commerce
30 Scott Corners Drive
Montgomery, NY 12549
(845) 457-9700 Ext. 1101
www.orangeny.com

25. Regional Alliance For Small Contractors
625 Eighth Avenue, 2nd Floor,
North Wing
New York, NY 10018
(212) 268-2991
www.regional-alliance.org

26 Women Builders Council
500 Hampton Avenue
Brooklyn, NY 11235
(212) 367-2130
www.wbcnyc.org

All such requests shall be in writing addressed to the Chief Engineer. If any such firm is determined to be eligible it shall only be by a writing over the name of the Chief Engineer. In the event that such firm is found not to be eligible, the Chief Engineer will only consider as a substitute for such firm, a firm listed in the Authority's MBE/WBE Directory available on-line.

The Contractor shall submit the names of proposed MBEs/WBEs for work on this Contract if their names do not appear in the Authority's MBE/WBE Directory available on-line in accordance with the requirements of this clause and all other requirements of this Contract. MBEs/WBEs proposed as lessors of equipment or materialmen shall be deemed "subcontractors" for the purpose of this numbered clause and the clause hereof entitled "Assignments and Subcontracts" but shall not be deemed subcontractors for any other purpose. However only 60% of the amounts paid by the Contractor to such materialmen who are MBEs/WBEs, except in the case of firms who themselves manufacture materials for use under the Contract, shall be allowed in computing the percentages of the Contract Price required to be paid to MBEs/WBEs hereunder.

The Contractor shall ensure that all approved MBE/WBE subcontractors maintain a regular on site presence at the construction site for the portions of the Work they are subcontracted to perform and that they exercise financial and operation management and control of such portions of the Work.

Nothing herein shall be deemed to supersede or to otherwise modify the clause of the Form of Contract entitled "Assignments and Subcontracts".

11. LOCAL BUSINESS ENTERPRISES (LBE) PROGRAM

A. Purpose

1.) The Authority has a long-standing practice of making its contract opportunities available to as many firms as possible and wishes to take affirmative steps to encourage Local Business Enterprises (LBEs) to seek business opportunities with it. The Authority expects the Contractor to use every good faith effort to maximize the participation of LBEs in the Work.

B. Local Definition

1.) Regarding this Contract, a "Local Business Enterprise" means a business entity *located in any of the following counties:*

a. • Richmond County, NY

b. • Hudson County, NJ

c. • Essex County, NJ

d. • Union Country, NJ

(i) Businesses are considered local if they satisfy the following:

(a.) • Minimum of Six Months of Continuous Operations. The business must have operated continuously in the Local Area for at least six months *prior to Award of Contract.*

(b.) • Business License. The business must possess a current New Jersey or New York Business License. The license must be issued at least six months prior to Award of Contract.

(c.) • Principal Place of Business. The business must demonstrate the majority of its operations and its primary office are based in the Local Area.

(d.) • Employees. The business must demonstrate that the majority of its employees, other than field employees, are based in its Principal Place of Business on the Local Area.

C. Good Faith Efforts

1.) In the event that the Contractor subcontracts any portion of the Work, the Contractor shall use and document every good faith effort to ensure LBE participation in the Work. Such good faith efforts shall include, at least, the following:

a. Dividing the Work, services, and materials to be subcontracted and/or procured into small portions where feasible.

b. Soliciting bids and giving reasonable advance notice (minimum two weeks), in local media, of portions of the Work to be subcontracted, and services and materials to be procured.

c. Attending any pre-bid meetings scheduled by the Port Authority, intended to notify and reach out to LBEs and provide the opportunity for the Contractor to build relationships with LBEs.

d. Post-award, hosting at least one outreach/meeting with LBEs, in the areas as defined in the above section, "Local Definition".

e. Submitting to the Authority a Participation Plan (Plan) no later than one month after contract award. The Plan shall include a summary of LBEs that the Contractor intends to retain and the work/services/supplies/materials expected to be provided by each LBE into the Work.

f. Reporting on LBE participation in "Payments to Contractors" form (same as M/WBE report), listing LBE name, address, product/service and amount ($) of Work to be provided, as well as maintaining a separate listing of LBE participation. This report shall be submitted on the first (1st) of the month to the Office of the Resident Engineer.

g. Retaining a Compliance Officer to monitor and execute good faith efforts for all M/W/LBE participation.

D. Additional information regarding LBE

1.) Nothing herein shall be deemed to supersede, or to otherwise modify the Information for Bidders clause entitled, "Minority and Women's Business Enterprise Program (M/WBE)" or Form of Contract clause entitled, "Assignments and Subcontracts".

2.) Subcontracts awarded to M//WBE firms in any of the locations defined in the above section, "Local Definition" will also count toward LBE participation.

12. INSPECTION OF SITE

Each bidder or his authorized representative must make proper arrangements with the Resident Engineer at the construction site before inspecting the construction site. To make such arrangements call Mostafa Yacoub, at (201) 216-2058 or email - myacoub@panynj.gov.

13. QUESTIONS BY BIDDERS

Questions by prospective bidders concerning the Contract may be addressed to Mitch Yonkler, at (201) 395-3452 or email myonkler@panynj.gov, who however is authorized only to direct the attention of prospective bidders to various portions of the Contract so that they may read and interpret such portions for themselves. Neither Mitchell Yonkler nor any other employee or representative of the Authority is authorized to give interpretations of any portion of the Contract or to give information as to the requirements of the Contract in addition to that contained in the Contract. Interpretations of the Contract or additional information as to its requirements, where necessary, shall be communicated to bidders only by written addendum issued over the name of the Chief Engineer, which addendum shall be considered part of this Contract. Accordingly, nothing contained herein and no representation, statement or promise, oral or in writing, of the Authority, its Commissioners, officers, agents, representatives or employees shall impair or limit the effect of the warranties of the Contractor contained in the clause of the Form of Contract entitled "Contractor's Warranties" or elsewhere in this Contract. The provisions of this clause shall apply to questions addressed by prospective bidders both before and after their receipt of Contract Documents.

14. PREVAILING RATE OF WAGE CERTIFICATION

The bidders' attention is directed specifically to the clause of the Form of Contract entitled "Prevailing Rate of Wage" and to the fact that the Authority requires a certification in writing from the successful bidder, in such form as may be required pursuant to such clause, that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause. This certification is required prior to his receipt of any payment from the Authority hereunder as provided in the clauses of the Form of Contract entitled "Monthly Advances" and "Final Payment" or at any other time.

15. CERTIFICATION OF NO INVESTIGATION (CRIMINAL OR CIVIL ANTI-TRUST), INDICTMENT, CONVICTION, SUSPENSION, DEBARMENT, DISQUALIFICATION, PREQUALIFICATION DENIAL OR TERMINATION, ETC; DISCLOSURE OF OTHER REQUIRED INFORMATION

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that the bidder and each parent and/or affiliate of the bidder has not (a) been indicted or convicted in any jurisdiction; (b) been suspended, debarred, found not responsible or otherwise disqualified from entering into contracts with any governmental agency or been denied a government contract for failure to meet prequalification standards; (c) had a contract terminated by any governmental agency for breach of contract or for any cause related directly or indirectly to an indictment or conviction; (d) changed its name and/or Employer Identification Number (taxpayer identification number) following its having been indicted, convicted, suspended, debarred or otherwise disqualified, or had a contract terminated as more fully provided in (a), (b) and (c) above; (e) ever used a name, trade name or abbreviated name, or an Employer Identification Number different from those inserted in the Proposal; (f) been denied a contract by any governmental agency for failure to provide the required security, including bid, payment or performance bonds or any alternative security deemed acceptable by the agency letting the contract; (g) failed to file any required tax returns or failed to pay any applicable federal, state or local taxes; (h) had a lien imposed upon its property based on taxes owed and fines and penalties assessed by any agency of the federal, state or local government; (i) been, and is not currently, the subject of a criminal investigation by any federal, state or local prosecuting or investigative agency and/or a civil anti-trust investigation by any federal, state or local prosecuting or investigative agency, including an inspector general of a governmental agency or public authority; (j) had any sanctions imposed as a result of a judicial or administrative proceeding with respect to any professional license held or with respect to any violation of a federal, state or local environmental law, rule or regulation; and (k) shared space, staff, or equipment with any business entity.

The foregoing certification as to "(a)" through "(k)" shall be deemed to have been made by the bidder as follows: if the bidder is a corporation, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each director and officer, as well as, to the best of the certifier's knowledge and belief, each stockholder with an ownership interest in excess of 10%; if the bidder is a partnership, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth an explanation for its uncertainty.

Notwithstanding that the certification may be an accurate representation of the bidder's status with respect to the enumerated circumstances provided for in this clause as requiring disclosure at the time that the bid is submitted, the bidder agrees to immediately notify the Authority in writing of any change in circumstances during the period of irrevocability, or any extension thereof.

The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority determines at any time prior or subsequent to the award of the Contract that the bidder has falsely certified as to any material item in the foregoing certification; willfully or fraudulently submitted any signed statement pursuant to this clause which is false in any material respect; or has not completely and accurately represented its status with respect to the circumstances provided for in this clause as requiring disclosure, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids and may, in addition to exercising any other rights or remedies available to it, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority". In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et seq.). Bidders are also advised that the inability to make such certification will not in and of itself disqualify a bidder, and that in each instance the Authority will evaluate the reasons therefor provided by the bidder.

Under certain circumstances the bidder may be required as a condition of this Contract award to enter into a Monitoring Agreement under which it will be required to take certain specified actions, including compensating an independent Monitor to be selected by the Port Authority. Said Monitor shall be charged with, among other things, auditing the actions of the bidder to determine whether its business practices and relationships indicate a level of integrity sufficient to permit it to continue business with the Port Authority.

As used in this clause, the following terms shall mean:

Affiliate - An entity in which the parent of the bidder owns more than fifty percent of the voting stock, or an entity in which a group of principal owners which owns more than fifty percent of the bidder also owns more than fifty percent of the voting stock.

Agency or Governmental Agency - Any federal, state, city or other local agency, including departments, offices, quasi-public agencies, public authorities and corporations, boards of education and higher education, public development corporations, local development corporations and others.

Employer Identification Number - The tax identification number assigned to firms by the Federal government for tax purposes.

Investigation - Any inquiries made by any federal, state or local criminal prosecuting or investigative agency, including an inspector general of a governmental agency or public authority, and any inquiries concerning civil anti-trust investigations made by any federal, state or local governmental agency. Except for inquiries concerning civil anti-trust investigations, the term does not include inquiries made by any civil government agency concerning compliance with any regulation, the nature of which does not carry criminal penalties, nor does it include any background investigations for employment, or Federal, state, and local inquiries into tax returns.

Officer - Any individual who serves as chief executive officer, chief financial officer, or chief operating officer of the bidder by whatever titles known.

Parent - An individual, partnership, joint venture or corporation which owns more than 50% of the voting stock of the bidder.

Space Sharing - Space shall be considered to be shared when any part of the floor space utilized by the submitting business at any of its sites is also utilized on a regular or intermittent basis for any purpose by any other business or not-for-profit organization, and where there is no lease or sublease in effect between the submitting business and any other business or not-for-profit organization that is sharing space with the submitting business.

Staff Sharing - Staff shall be considered to be shared when any individual provides the services of an employee, whether paid or unpaid, to the bidder and also, on either a regular or irregular basis, provides the services of an employee, paid or unpaid, to one or more other business(es) and/or not-for-profit organization(s), if such services are provided during any part of the same hours the individual is providing services to the bidder or if such services are provided on an alternating or interchangeable basis between the bidder and the other business(es) or not-for-profit organization(s). "The services of an employee" should be understood to include services of any type or level, including managerial or supervisory. This type of sharing may include, but is not limited to, individuals who provide the following services: telephone answering, receptionist, delivery, custodial, and driving.

Equipment Sharing - Equipment shall be considered to be shared whenever the bidder shares the ownership and/or the use of any equipment with any other business or not-for-profit organization. Such equipment may include, but is not limited to, telephones or telephone systems, photocopiers, computers, motor vehicles, and construction equipment. Equipment shall not be considered to be shared under the following two circumstances: when, although the equipment is owned by another business or not-for-profit organization, the bidder has entered into a formal lease for the use of the equipment and exercises exclusive use of the equipment; or when the bidder owns equipment that it has formally leased to another business or not-for-profit organization, and for the duration of such lease the bidder has relinquished all right to the use of such leased equipment.

16. NON-COLLUSIVE BIDDING AND CODE OF ETHICS CERTIFICATION; CERTIFICATION OF NO SOLICITATION BASED ON COMMISSION, PERCENTAGE, BROKERAGE, CONTINGENT FEE OR OTHER FEE

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that: (a) the prices in its bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor; (b) the prices quoted in its bid have not been and will not be knowingly disclosed, directly or indirectly, by the bidder prior to the official opening of such bid to any other bidder or to any competitor; (c) no attempt has been made and none will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition; (d) this organization has not made any offers or agreements, or given or agreed to give anything of value (see definition of "anything of value" appearing in the clause of the Form of Contract entitled "No Gifts, Gratuities, Offers of Employment, etc.") or taken any other action with respect to any Authority employee or former employee or immediate family member of either which would constitute a breach of ethical standards under the Code of Ethics and Financial Disclosure dated as of April 11, 1996 (a copy of which is available upon request to the individual named in the clause hereof entitled "Questions by Bidders"), nor does this organization have any knowledge of any act on the part of an Authority employee or former Authority employee relating either directly or indirectly to this organization which constitutes a breach of the ethical standards set forth in said Code; (e) no person or selling agency, other than a bona fide employee or bona fide established commercial or selling agency maintained by the bidder for the purpose of securing business, has been employed or retained by the bidder to solicit or secure this Contract on the understanding that a commission, percentage, brokerage, contingent or other fee would be paid to such person or selling agency; (f) the bidder has not offered, promised or given, demanded or accepted, any undue advantage, directly or indirectly, to or from a public official or employee, political candidate, party or party official, or any private sector employee (including a person who directs or works for a private sector enterprise in any capacity), in order to obtain, retain, or direct business or to secure any other improper advantage in connection with this Contract.

The foregoing certification as to "(a)", "(b)", "(c)", "(d)", "(e)" and "(f)" shall be deemed to have been made by the bidder as follows: if the bidder is a corporation, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each parent, affiliate, director and officer of the bidder, as well as, to the best of the certifier's knowledge and belief, each stockholder of the bidder with an ownership interest in excess of 10%; if the bidder is a partnership, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth in such statement the reasons for its uncertainty. As a result of such disclosure, the Port Authority shall take appropriate action up to and including a finding of non-responsibility.

Failure to make the required disclosures shall lead to administrative actions up to and including a finding of non-responsibility.

Notwithstanding that the bidder may be able to make the foregoing certification at the time the bid is submitted, the bidder shall immediately notify the Authority in writing during the period of irrevocability of bids on this Contract or any extension of such period, of any change of circumstances which might under this clause make it unable to make the foregoing certification or required disclosure. The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority should determine at any time prior or subsequent to the award of this Contract that the bidder has falsely certified as to any material item in the foregoing certification or has willfully or fraudulently furnished a signed statement which is false in any material respect, or has not fully and accurately represented any circumstance with respect to any item in the foregoing certification required to be disclosed, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids on Authority contracts and may, in addition to exercising any other rights or remedies it may have, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority".

In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et seq.). Bidders are also advised that the inability to make such certification will not in and of itself disqualify a bidder, and that in each instance the Authority will evaluate the reasons therefor provided by the bidder.

Under certain circumstances the bidder may be required as a condition of this Contract award to enter into a Monitoring Agreement under which it will be required to take certain specified actions, including compensating an independent Monitor to be selected by the Port Authority. Said Monitor shall be charged with, among other things, auditing the actions of the bidder to determine whether its business practices and relationships indicate a level of integrity sufficient to permit it to continue business with the Port Authority.

17. BIDDER ELIGIBILITY FOR AWARD OF CONTRACTS - DETERMINATIONS BY AN AGENCY OF THE STATE OF NEW YORK OR NEW JERSEY CONCERNING ELIGIBILITY TO RECEIVE PUBLIC CONTRACTS

Bidders are advised that the Authority has adopted a policy to the effect that in awarding its contracts it will honor any determination by an agency of the State of New York or New Jersey that a bidder is not eligible to bid on or be awarded public contracts because the bidder has been determined to have engaged in illegal or dishonest conduct or to have violated prevailing rate of wage legislation.

The policy permits a bidder whose ineligibility has been so determined by an agency of the State of New York or New Jersey to submit a bid on a Port Authority contract and then to establish that it is eligible to be awarded the contract on which it has bid because (i) the state agency determination relied upon does not apply to the bidder, or (ii) the state agency determination relied upon was made without affording the bidder the notice and hearing to which the bidder was entitled by the requirements of due process of law, or (iii) the state agency determination was clearly erroneous or (iv) the state agency determination relied upon was not based on a finding of conduct demonstrating a lack of integrity or a violation of a prevailing rate of wage law.

The full text of the resolution adopting the policy may be found in the Minutes of the Authority's Board of Commissioners meeting of September 9, 1993.

18. APPRENTICESHIP PROGRAMS

The Authority is a participant in both the Edward J. Malloy Construction Initiative for Construction Skills and Construction Careers, cooperative programs among schools, union and public agencies in New York and New Jersey respectively. The Edward J. Malloy Construction Initiative for Construction Skills and Construction Careers create career opportunities in the construction industry for high school graduates by providing systematic pathways into union-sponsored, skilled trade apprenticeship programs. The Authority encourages contractors and their subcontractors to maximize the use of apprentices under the applicable collective bargaining agreements or as contained in the applicable programs approved by the New York State Department of Labor or United States Department of Labor. The Contractor's plan for utilizing apprentices will be discussed at the pre-construction meeting.

Each subcontractor proposed for approval under the Contract whose total amount of subcontracts under this Contract is greater than $1 million and each bidder (except as set forth in the certification below) will be required to certify as to their participation in either a New York State-registered or United States Department of Labor–registered apprenticeship program.

19. CERTIFICATION OF PARTICIPATION IN A STATE-REGISTERED OR UNITED STATES DEPARTMENT OF LABOR-REGISTERED APPRENTICESHIP PROGRAM

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that the bidder participates in an apprenticeship program registered by either the New York State Department of Labor or the United States Department of Labor. Participation in such an apprenticeship program shall mean that the bidder either (a) is a signatory to a collective bargaining agreement with a labor organization which sponsors an apprenticeship program registered with the New York State Department of Labor or United States Department of Labor or (b) individually sponsors an apprenticeship program registered by the New York State Department of Labor or United States Department of Labor and, in the case of both (a) and (b) above, such apprenticeship program shall be in the trade(s) in which Work is to be performed. This clause shall not apply to bidders who will perform all Work at the construction site through the use of subcontractors.

The foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth an explanation for its uncertainty.

Notwithstanding that the certification may be an accurate representation of the bidder's status with respect to the enumerated circumstances provided for in this clause as requiring disclosure at the time that the bid is submitted, the bidder agrees to immediately notify the Authority in writing of any change in circumstances during the period of irrevocability, or any extension thereof.

The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority determines at any time prior or subsequent to the award of the Contract that the bidder has falsely certified as to any material item in the foregoing certification; willfully or fraudulently submitted any signed statement pursuant to this clause which is false in any material respect; or has not completely and accurately represented its status with respect to the circumstances provided for in this clause as requiring disclosure, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids and may, in addition to exercising any other rights or remedies available to it, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority". In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see, e.g., New York Penal Law, Section 175.30 et seq.).

20. JOB MIX SUBMITTAL

A bidder may be directed by the Chief Engineer in writing to proceed with design of the asphalt concrete mix specified in the Section of the Specifications entitled "Asphalt Concrete Paving" prior to acceptance of one of the Proposals. If so directed by the Chief Engineer, the bidder shall immediately prepare the design of the asphalt concrete mix and submit it to the Engineer for approval as specified in the aforementioned Section of the Specifications.

All drawings, data and written materials of any type whatsoever which are prepared in connection with the preparation of such design and submitted to the Authority shall be subject to the Section of the Specifications entitled "Shop Drawings, Catalog Cuts and Samples". All materials submitted to the Authority shall be subject to the Section of the Specifications entitled "Workmanship and Materials" and upon submission to the Authority, they shall become the property of the Authority.

None of the requirements of the Contract shall be altered in any way as a result of a bidder being or not being so directed by the Chief Engineer prior to acceptance of one of the Proposals.

In the event that the Proposal of the bidder who was so directed by the Chief Engineer is accepted then no compensation other than that provided in the Form of Contract shall be paid to said bidder.

In the event design of the asphalt concrete mix has been prepared and for any reason thereafter the Proposal of the bidder who was directed by the Chief Engineer to prepare such design is not accepted, then such bidder shall be reimbursed for the cost of the preparation of the design in the amount to be agreed to by the Chief Engineer and the bidder but not to exceed a total amount of Five Thousand Dollars ($5,000.00) regardless of the actual cost to such bidder connected with the preparation of such design.

As used in this numbered clause the term "cost of the preparation of the design" means the cost to the Contractor of materials submitted, the initial design submitted, any resubmittals required by the Engineer and all testing and analysis of the design.

PROPOSAL

To The Port Authority of New York and New Jersey:

The undersigned[5]

Skanska Koch Inc., an organization organized under the laws of the State of Delaware and
Kiewit Infrastructure Co., an organization organized under the laws of the State of Delaware to form
Skanska Koch - Kiewit, JV

(hereinafter called "the Contractor") hereby offers to perform all the obligations and to assume all the duties and liabilities of the Contractor provided for in the annexed Contract, at the prices inserted by the undersigned in the clauses of the Form of Contract entitled "Unit Prices" and "Contractor's Compensation".

This offer shall be irrevocable for one hundred twenty (120) days after the date on which The Port Authority of New York and New Jersey opens this Proposal.

To induce the acceptance of this Proposal, the undersigned hereby makes each and every certification, statement, assurance, representation and warranty made by the Contractor in said Contract. Moreover as a condition to receipt and consideration by the Authority of the Proposal whether or not it is accepted, the undersigned agrees that all information of any nature whatsoever, regardless of the form of the communication, received from the undersigned (including its officers, agents, or employees) by the Authority, its Commissioners, officers, agents or employees, and notwithstanding any statement therein to the contrary, has not been given in confidence and may be used or disclosed by or on behalf of the Authority without liability of any kind except as may arise under letters patent of the undersigned, if any.

---

5 *Insert bidder's name at the top of the page. After the bidder's name, insert one of the following phrases:*

If a corporation, give state of incorporation, using the phrase, "a corporation organized under the laws of the State of ."

If a partnership, give full names of partners, using also the phrase, "co-partners doing business under the firm name of ."

If an individual using a trade name, give individual name, using also the phrase, "an individual doing business under the trade name of ."

If a joint venture, give the information required above for each participant in the joint venture.

Unless expressly stated otherwise, the Information for Bidders, all papers required by it and submitted in connection herewith at any time, said Form of Contract, and all papers made part of the Contract by the terms of the Form of Contract are made part of this Proposal.

The undersigned hereby designates the following as the bidders office[6]:

Skanska Koch Inc.

400 Roosevelt Ave.

Carteret, NJ 07008

The telephone number of the bidder is: 732-366-7121

The fax number of the bidder is: 732-366-7001

The E-Mail address of the bidder is: tony.taddeo@skanska.com

6 Insert office address.

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:04

SIGNATURE AND CERTIFICATE OF AUTHORITY[7]

Dated, April 17, 20 13

(Signature of individual or name of corporation or partnership) Skanska Koch - Kiewit JV

(Signature of agent, partner or corporate officer)

By[8 9] Robert W. Koch

(Acknowledgment of signature to be taken on proper form on following page(s))

CERTIFICATE OF AUTHORITY, IF BIDDER IS A CORPORATION

I, the undersigned, as Secretary of the corporation submitting the foregoing Proposal, hereby certify that under and pursuant to the by-laws and resolutions of said corporation, each officer who has signed said Proposal on behalf of the corporation is fully and completely authorized so to do.

(Corporate Seal)

---

7 If bidder is a joint venture, insert signatures as appropriate for one participant of the joint venture on this page and attach and complete an additional signature sheet in the same form as appears on this page for each other participant as required.

8 If Proposal is signed by an officer or agent, give title.

9 NOTE: The foregoing signature shall be deemed to have been provided with full knowledge that the foregoing Proposal, the accompanying Contract booklet, as well as any certification, statement, assurance, representation, warranty, schedule or other document submitted by the bidder with the Proposal will become a part of the records of the Authority and that the Authority will rely in awarding the Contract on the truth and accuracy of such Proposal and each such certification, statement, assurance, representation, warranty and schedule made therein by the Contractor. Knowingly submitting a false statement in connection with any of the foregoing may be the basis for prosecution for offering a false instrument for filing (see, e.g., N.Y. Penal Law, Section 175.30 et seq.).

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:04

ACKNOWLEDGMENT[10]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Middlesex

On this 17th day of April, 2013 before me personally came and appeared Robert W. Koch, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the President/CEO of Skanska-Koch Inc., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal)

Jo-Ann Puskas

(Notary Signature)

JO-ANN PUSKAS
Notary Public of New Jersey
My Commission Expires April 21, 2017

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

(Notary Signature)

---

10 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

SIGNATURE AND CERTIFICATE OF AUTHORITY[7]

Dated, April 17, 20 13

(Signature of individual or name of corporation or partnership) Skanska Koch Inc.

(Signature of agent, partner or corporate officer)

By[8,9] Robert W. Koch, President/CEO

(Acknowledgment of signature to be taken on proper form on following page(s))

CERTIFICATE OF AUTHORITY, IF BIDDER IS A CORPORATION

I, the undersigned, as Secretary of the corporation submitting the foregoing Proposal, hereby certify that under and pursuant to the by-laws and resolutions of said corporation, each officer who has signed said Proposal on behalf of the corporation is fully and completely authorized so to do.

(Corporate Seal)

Stephen Hughes, Secretary

---

7 If bidder is a joint venture, insert signatures as appropriate for one participant of the joint venture on this page and attach and complete an additional signature sheet in the same form as appears on this page for each other participant as required.

8 If Proposal is signed by an officer or agent, give title.

9 NOTE: The foregoing signature shall be deemed to have been provided with full knowledge that the foregoing Proposal, the accompanying Contract booklet, as well as any certification, statement, assurance, representation, warranty, schedule or other document submitted by the bidder with the Proposal will become a part of the records of the Authority and that the Authority will rely in awarding the Contract on the truth and accuracy of such Proposal and each such certification, statement, assurance, representation, warranty and schedule made therein by the Contractor. Knowingly submitting a false statement in connection with any of the foregoing may be the basis for prosecution for offering a false instrument for filing (see, e.g., N.Y. Penal Law, Section 175.30 et seq.).

PROCUREMENT (MAIL CENTER) 2013 APR 17 PM 3:03

ACKNOWLEDGMENT[10]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Middlesex

On this 17th day of April, 2013, before me personally came and appeared Robert W. Koch, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the President/CEO of Skanska-Koch Inc., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal) John Papagiannakis
ID # 2349304
Notary Public of New Jersey
Commission Expires: 9/14/2016

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

(Notary Signature)

---

10 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

SIGNATURE AND CERTIFICATE OF AUTHORITY[7]

Dated, 4/15/2013, 20

(Signature of individual or name of corporation or partnership)

Kiewit Infrastructure Co.

(Signature of agent, partner or corporate officer)

By[8 9]

(Acknowledgment of signature to be taken on proper form on following page(s))

Gregory A. Hill, Senior Vice President

CERTIFICATE OF AUTHORITY, IF BIDDER IS A CORPORATION

I, the undersigned, as Secretary of the corporation submitting the foregoing Proposal, hereby certify that under and pursuant to the by-laws and resolutions of said corporation, each officer who has signed said Proposal on behalf of the corporation is fully and completely authorized so to do.

(Corporate Seal)

Trent Andres , Assistant Secretary

PROCUREMENT (MAIL CENTER)
2013 APR 17 PM 3:03

7 If bidder is a joint venture, insert signatures as appropriate for one participant of the joint venture on this page and attach and complete an additional signature sheet in the same form as appears on this page for each other participant as required.

8 If Proposal is signed by an officer or agent, give title.

9 NOTE: The foregoing signature shall be deemed to have been provided with full knowledge that the foregoing Proposal, the accompanying Contract booklet, as well as any certification, statement, assurance, representation, warranty, schedule or other document submitted by the bidder with the Proposal will become a part of the records of the Authority and that the Authority will rely in awarding the Contract on the truth and accuracy of such Proposal and each such certification, statement, assurance, representation, warranty and schedule made therein by the Contractor. Knowingly submitting a false statement in connection with any of the foregoing may be the basis for prosecution for offering a false instrument for filing (see, e.g., N.Y. Penal Law, Section 175.30 et seq.).

ACKNOWLEDGMENT[10]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Bergen

On this 15th day of April, 2013, before me personally came and appeared Gregory A. Hill, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the Senior VP of Kiewit Infrastructure Co., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal) Subscribed and sworn to before me in my presence this 15th day of April, 2013, a Notary Public in and for the State of New Jersey.

Donna A. Carpentier
(Notary Signature)

Donna A. Carpentier
Notary Public
My Commission expires March 12, 2016.

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

_____
(Notary Signature)

PROCUREMENT (MAIL CENTER) 2013 APR 17 PM 3:03

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

_____
(Notary Signature)

---

10 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

CONTRACT AKB-264.039

STATEMENT ACCOMPANYING PROPOSAL[11]

Names and Residences of Officers, If Bidder is a Corporation

Name	Title	Residence[12]
Please see enclosed "Papers Accompanying Proposal"		

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

Names and Residences of Partners, If Bidder is a Partnership

Name	General or Limited Partner	Residence[13]

Bidder's Residence, If an Individual[14]

---

11 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Statement Accompanying Proposal sheet in the same form as appears on this page for each other participant as required.

12 Give Street and Number of Residence. Do not give business address.

13 Give Street and Number of Residence. Do not give business address.

14 Give Street and Number of Residence. Do not give business address.

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned[15]

as principal(s); and[16]

as surety are hereby held and firmly bound unto The Port Authority of New York and New Jersey (herein called the "Authority") in the penal sum of Fifty Million Dollars ($50,000,000), for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this day of , 20

The condition of the above obligation is such that whereas the above named principal(s) has submitted to the Authority a certain Proposal, bound herewith and hereby made a part hereof, to perform the obligations of the Contractor under a contract in writing, known as Contract AKB-264.039, "Bayonne Bridge - Bayonne Bridge - Replacement of Main Span Roadway and Approach Structures", now therefore:

A. If said Proposal shall not be accepted, or

B. If said Proposal shall be accepted and the Authority does not require the principal(s) to furnish a Performance and Payment Bond, or

C. If said Proposal shall be accepted and the Authority requires the principal(s) to furnish a Performance and Payment Bond and either the principal(s) furnishes a Performance and Payment Bond satisfactory to the Authority in accordance with the requirements of said Proposal or the Authority does not terminate the Contract as provided therein on account of the failure to furnish such a bond,

Then, this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

---

15 Insert bidder's name. If a corporation, give the state of incorporation using the phrase "a corporation organized under the laws of the ".

If a partnership, give full names of partners, using also the phrase, "co-partners doing business under the firm name of ".

If an individual using a trade name, give individual name; using also the phrase, "an individual doing business under the trade name of ".

If a joint venture, give the information required above for each participant in the joint venture.

16 Insert name of surety.

Bond

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned[15] Skanska Koch-Kiewit JV a Joint Venture comprised of the following entities: Skanska Koch Inc, a Delaware Corporation and Kiewit Infrastructure Co., a Delaware Company

as principal(s); and[16] Fidelity and Deposit Company of Maryland/Zurich American Insurance Company
1400 American Lane, Schaumburg, IL 60196

as surety are hereby held and firmly bound unto The Port Authority of New York and New Jersey (herein called the "Authority") in the penal sum of Fifty Million Dollars ($50,000,000), for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

2013 APR 17 PM 2:03
PROCUREMENT
(MAIL CENTER)

Signed this 12th day of April ,20 13

The condition of the above obligation is such that whereas the above named principal(s) has submitted to the Authority a certain Proposal, bound herewith and hereby made a part hereof, to perform the obligations of the Contractor under a contract in writing, known as Contract AKB-264.039, "Bayonne Bridge - Bayonne Bridge - Replacement of Main Span Roadway and Approach Structures", now therefore:

A. If said Proposal shall not be accepted, or

B. If said Proposal shall be accepted and the Authority does not require the principal(s) to furnish a Performance and Payment Bond, or

C. If said Proposal shall be accepted and the Authority requires the principal(s) to furnish a Performance and Payment Bond and either the principal(s) furnishes a Performance and Payment Bond satisfactory to the Authority in accordance with the requirements of said Proposal or the Authority does not terminate the Contract as provided therein on account of the failure to furnish such a bond,

Then, this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

---

15 Insert bidder's name. If a corporation, give the state of incorporation using the phrase "a corporation organized under the laws of the ".

If a partnership, give full names of partners, using also the phrase, "co-partners doing business under the firm name of ".

If an individual using a trade name, give individual name, using also the phrase, "an individual doing business under the trade name of ".

If a joint venture, give the information required above for each participant in the joint venture.

16 Insert name of surety.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance and Payment Bond or by any waiver by the Authority of any of the requirements of said Proposal; and said surety does hereby waive notice of any such extensions or waivers.

IN WITNESS WHEREOF, the principal(s) and surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

Skanska Koch Inc.

(Seal)

Principal [17]

By[18]

Fidelity and Deposit Company of Maryland/
Zurich American Insurance Company

Surety

(Seal)

By[19]

Beverly A. Woolford, Attorney-in-Fact

---

17 If bidder is a joint venture, insert signature and information required as appropriate for one participant of the joint venture on this page and attach and complete an additional sheet in the same form as appears on this page for each other participant as required.

18 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

19 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance and Payment Bond or by any waiver by the Authority of any of the requirements of said Proposal; and said surety does hereby waive notice of any such extensions or waivers.

IN WITNESS WHEREOF, the principal(s) and surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

2013 APR 17 PM 3:03
PROCUREMENT
(MAIL CENTER)

Skanska Koch-Kiewit JV

Principal[17]

(Seal)

By[18]

Fidelity and Deposit Company of Maryland/
Zurich American Insurance Company

Surety

(Seal)

By[19]

Beverly A. Woolford, Attorney-in-Fact

17 If bidder is a joint venture, insert signature and information required as appropriate for one participant of the joint venture on this page and attach and complete an additional sheet in the same form as appears on this page for each other participant as required.

18 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

19 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance and Payment Bond or by any waiver by the Authority of any of the requirements of said Proposal; and said surety does hereby waive notice of any such extensions or waivers.

IN WITNESS WHEREOF, the principal(s) and surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Kiewit Infrastructure Co.

Gregory A. Hill

Principal [17] Senior Vice President

(Seal)

By[18] _____

Fidelity and Deposit Company of Maryland/
Zurich American Insurance Company

Surety

(Seal)

By[19] Beverly A. Woolford

Beverly A. Woolford
Attorney-in-Fact

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

---

17 If bidder is a joint venture, insert signature and information required as appropriate for one participant of the joint venture on this page and attach and complete an additional sheet in the same form as appears on this page for each other participant as required.

18 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

19 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:03

ACKNOWLEDGMENT[20]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Middlesex

On this 12th day of April, 2013, before me personally came and appeared Robert [illegible] to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the President of Shepada Kreb [illegible], the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal)

Jo-Ann Puskas

(Notary Signature)

JO-ANN PUSKAS
Notary Public of New Jersey
My Commission Expires April 21, 2017

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

_____

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of. _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

_____

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

---

20 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

ACKNOWLEDGMENT[20]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Bergen

On this 15th day of April, 2013 before me personally came and appeared Gregory A. Hill, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the Senior Vice President of Kiewit Infrastructure Co., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal)

Donna A. Carpentier

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

(Notary Signature)

2013 APR 17 PM 3:03
PROCUREMENT
(MAIL CENTER)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of. _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

---

20 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

SURETY DISCLOSURE STATEMENT AND CERTIFICATION

pursuant to N.J.S.A. 2A:44-143

(for use when surety(ies) have a certificate from U.S. Secretary of the Treasury in accordance with 31 U.S.C.§9305)

Fidelity and Deposit Company of Maryland ,

surety on the attached bond, hereby certifies the following:

(1) The surety meets the applicable capital and surplus requirements of R.S.17:17-6 or R.S.17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital and surplus, as determined in accordance with the applicable laws of this State, of the surety participating in the issuance of the attached bond is in the following amounts as of the calendar year ended December 31, 2011 which amounts have been certified on a Certification by PricewaterhouseCoopers, LLP and are included in the Annual Statement on file with the New Jersey Department of Insurance, 20 West State Street CN-325, Trenton, New Jersey 08625-0325.

Fidelity and Deposit Company of Maryland , $194,791,087

With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. §9305, the underwriting limitation established therein on July 1, 2011 is as follows:

Fidelity and Deposit Company of Maryland , $16,970,000

The amount of the bond to which the statement and certification is attached is $50,000,000.00.

(1) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in item (3) above, then for each such contract of reinsurance:

(a) The name and address of each such insurer under that contract and the amount of the reinsurer's participation in the contract is as follows:

and;

(b) Each surety that is party to any such contract of reinsurance certifies that each insurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under P.L. 1993, c.243(C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

CERTIFICATE

I, Frank E. Martin., as Vice President for Fidelity and Deposit, a corporation domiciled in Maryland, DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements made by me are false, this bond is VOIDABLE.

Frank E. Martin Jr

Frank E. Martin, Jr., Vice President

Dated: 4/12/13

Effective: April 13, 2012

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Maryland, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Maryland (herein collectively called the "Companies"), by **THOMAS O. MCCLELLAN, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **James E. MARRAN, JR, David W. ROSEHILL, Nancy SCHNEE, Andrea E. GORBERT, Annette LEUSCHNER, Valorie SPATES, Beverly A. WOOLFORD and Anne POTTER, all of Jericho, New York, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 5th day of February, A.D. 2013.

ATTEST:

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

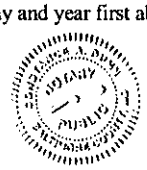
By: _____
Assistant Secretary
Eric D. Barnes

_____
Vice President
Thomas O. McClellan

State of Maryland
City of Baltimore

On this 5th day of February, A.D. 2013, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **THOMAS O. MCCLELLAN, Vice President, and ERIC D. BARNES, Assistant Secretary,** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.



_____
Constance A. Dunn, Notary Public
My Commission Expires: July 14, 2015

POA-F 093-7185C

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify of revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this ____ day of APR 1 2 2013 0____.

Geoffrey Delisio

Geoffrey Delisio, Vice President

SURETY DISCLOSURE STATEMENT AND CERTIFICATION

pursuant to N.J.S.A. 2A:44-143

(for use when surety(ies) have a certificate from U.S. Secretary of the Treasury in accordance with 31 U.S.C.§9305)

Zurich American Insurance Company ,

surety on the attached bond, hereby certifies the following:

(1) The surety meets the applicable capital and surplus requirements of R.S.17:17-6 or R.S.17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital and surplus, as determined in accordance with the applicable laws of this State, of the surety participating in the issuance of the attached bond is in the following amounts as of the calendar year ended December 31, 2011 which amounts have been certified on a Certification by PricewaterhouseCoopers, LLP and are included in the Annual Statement on file with the New Jersey Department of Insurance, 20 West State Street CN-325, Trenton, New Jersey 08625-0325.

Zurich American Insurance Company , $7,018,779,407

With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. §9305, the underwriting limitation established therein on July 1, 2012 is as follows:

Zurich American Insurance Company , $630,629,000

The amount of the bond to which the statement and certification is attached is $50,000,000.00.

(1) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in item (3) above, then for each such contract of reinsurance:

(a) The name and address of each such insurer under that contract and the amount of the reinsurer's participation in the contract is as follows:

and;

(b) Each surety that is party to any such contract of reinsurance certifies that each insurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under P.L. 1993, c.243(C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

CERTIFICATE

I, Geoffrey Delisio, as Vice President for Zurich American Insurance Company, a corporation domiciled in New York, DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements made by me are false, this bond is VOIDABLE.

Geoffrey Delisio

Geoffrey Delisio, Vice President

Dated: 4/12/13

Effective: July 1, 2012

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

ACKNOWLEDGEMENT BY JOINT VENTURE

STATE OF **New Jersey**)
COUNTY OF Middlesex)

ON THE 12th DAY OF **April** 2013, BEFORE ME PERSONALLY CAME Robert Koch A MEMBER OF THE JOINT VENTURE OF **Skanska Koch-Kiewit JV** TO ME KNOWN AND KNOWN TO ME TO BE THE PERSON DESCRIBED IN AND WHO EXECUTED THE FOREGOING INSTRUMENT AND ACKNOWLEDGED TO ME THAT (S)HE EXECUTED THE SAME AS AND FOR THE ACT AND DEED OF THE SAID JOINT VENTURE.

Jo-Ann Puskas
Notary Public

JO-ANN PUSKAS
Notary Public of New Jersey
My Commission Expires April 21, 2017

ACKNOWLEDGEMENT OF SURETY

STATE OF NEW YORK,)
COUNTY OF NASSAU,)

ON THE **12th** DAY OF **April**, 2013, BEFORE ME PERSONALLY CAME **Beverly A. Woolford** TO ME KNOWN, WHO, BEING BY ME DULY SWORN, DID DEPOSE AND SAY THAT (S)HE RESIDES AT **Queens County, New York** THAT (S)HE IS THE ATTORNEY-IN-FACT OF **Fidelity and Deposit Company of Maryland/Zurich American Insurance Company** THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; THAT (S)HE KNOWS THE SEAL OF SAID CORPORATION; THAT ONE OF THE SEALS AFFIXED TO THE FOREFGOING INSTRUMENT IS SUCH SEAL; THAT IT WAS SO AFFIXED BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY LIKE ORDER.

Andrea E. Gorbert
Notary Public

ANDREA E. GORBERT
Notary Public, State of New York
No. 01GO6170063
Qualified in Suffolk County
Commission Expires July 02, 2015

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

ACKNOWLEDGEMENT OF CONTRACTOR, IF A CORPORATION

STATE OF New Jersey
COUNTY OF Middlesex

ON THE 12th DAY OF **April** 2013, BEFORE ME PERSONALLY CAME Robert Koch TO ME KNOWN WHO BEING BY ME DULY SWORN DID DEPOSE AND SAY THAT (S)HE RESIDES AT
THAT (S)HE IS THE President OF **Skanska Koch Inc.**
THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION.

Jo-Ann Puskas
Notary Public

JO-ANN PUSKAS
Notary Public of New Jersey
My Commission Expires April 21, 2017

ACKNOWLEDGEMENT OF SURETY

STATE OF NEW YORK,)
COUNTY OF NASSAU,)

ON THE **12th** DAY OF **April** 2013, BEFORE ME PERSONALLY CAME **Beverly A. Woolford** TO ME KNOWN, WHO, BEING BY ME DULY SWORN, DID DEPOSE AND SAY THAT (S)HE RESIDES AT **Queens County, New York** THAT (S)HE IS THE ATTORNEY-IN-FACT OF **Fidelity and Deposit Company of Maryland/Zurich American Insurance Company** THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; THAT (S)HE KNOWS THE SEAL OF SAID CORPORATION; THAT ONE OF THE SEALS AFFIXED TO THE FOREFGOING INSTRUMENT IS SUCH SEAL; THAT IT WAS SO AFFIXED BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY LIKE ORDER.

Andrea E. Gorbert
Notary Public

ANDREA E. GORBERT
Notary Public, State of New York
No. 01GO6170063
Qualified in Suffolk County
Commission Expires July 02, 2015

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

ACKNOWLEDGEMENT OF CONTRACTOR, IF A CORPORATION

STATE OF Jersey ,)
COUNTY OF Bergen ,)

ON THE 12th DAY OF **April** 2013, BEFORE ME PERSONALLY CAME Gregory A. Hill TO ME KNOWN, WHO, BEING BY ME DULY SWORN, DID DEPOSE AND SAY THAT (S)HE RESIDES AT Stony Point, NY. , THAT (S)HE IS THE Senior Vice President OF **Kiewit Infrastructure Co.** THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION.

Donna A. Carpentier
Notary Public

Subscribed and sworn to before me in my presence this 12th day of April, 20 13, a Notary Public in and for the State of New Jersey.
Donna A Carpentier
Notary Public
My Commission expires March 12, 20 16.

ACKNOWLEDGEMENT OF SURETY

STATE OF NEW YORK,)
COUNTY OF NASSAU,)

ON THE **12th** DAY OF **April** 2013, BEFORE ME PERSONALLY CAME **Beverly A. Woolford** TO ME KNOWN, WHO, BEING BY ME DULY SWORN, DID DEPOSE AND SAY THAT (S)HE RESIDES AT **Queens County, New York** THAT (S)HE IS THE ATTORNEY-IN-FACT OF **Fidelity and Deposit Company of Maryland/Zurich American Insurance Company** THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; THAT (S)HE KNOWS THE SEAL OF SAID CORPORATION; THAT ONE OF THE SEALS AFFIXED TO THE FOREFGOING INSTRUMENT IS SUCH SEAL; THAT IT WAS SO AFFIXED BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY LIKE ORDER.

Andrea E Gorbert
Notary Public

ANDREA E. GORBERT
Notary Public, State of New York
No. 01GO6170063
Qualified in Suffolk County
Commission Expires July 02, 20 15

POWER OF ATTORNEY

Know all men by these presents that **Kiewit Infrastructure Co.** a corporation organized under the laws of the State of Delaware, and having a business office in **Woodcliff Lake, New Jersey** made, constituted and appointed, and does by these presents make, constitute and appoint **Robert Koch**, its true and lawful Attorney In-Fact, with full power and authority hereby conferred to sign, execute and acknowledge all proposals and associated documents related to the joint venture with Skanska Koch submitted to the Port Authority of New York and New Jersey for the sealed bid AKB 264.039 Bayonne Bridge – Replacement of Main Span Roadway and Approach Structures Project being bid as **Skanska-Kiewit JV** and to bind Kiewit Infrastructure Co. thereby as fully and to the same extent as if the same were signed by the duly authorized officers of Kiewit Infrastructure Co. and all the acts of said Attorneys-In-Fact are hereby ratified and confirmed.

In Witness Whereof, **Kiewit Infrastructure Co.** has caused this instrument to be signed by its Senior Vice President this **1st day of April, 2013**

Gregory A. Hill, Senior Vice President

STATE OF New Jersey
COUNTY OF Bergen

On this **1st day of April , 2013** before me personally came Gregory A. Hill to me known, who, being by me duly sworn, did depose and say that he is the Senior Vice President of **Kiewit Infrastructure Co.** the corporation described in and which executed the above instrument: that he executed the said instrument on behalf of the corporation by authority of the above Resolution.

Donna A. Carpentier
Notary

Subscribed and sworn to before me in my presence this 1st day of April, 20 13, a Notary Public in and for the State of New Jersey
Donna A. Carpentier
Notary Public
My Commission expires March 12, 20 16.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance and Payment Bond or by any waiver by the Authority of any of the requirements of said Proposal; and said surety does hereby waive notice of any such extensions or waivers.

IN WITNESS WHEREOF, the principal(s) and surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____

Principal [17]

(Seal)

By[18] _____

_____

Surety

(Seal)

By[19] _____

---

17 If bidder is a joint venture, insert signature and information required as appropriate for one participant of the joint venture on this page and attach and complete an additional sheet in the same form as appears on this page for each other participant as required.

18 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

19 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

ACKNOWLEDGMENT[20]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the _____ of _____, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

_____ SS:

County of _____

On this _____ day of. _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal) _____

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

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20 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

FORM OF CONTRACT

CHAPTER I

GENERAL PROVISIONS

21. DEFINITIONS

To avoid undue repetition, the following terms whenever they occur in this Form of Contract or any of the other papers forming a part of the Contract shall be construed as follows:

"Contract" shall mean, in addition to this Form of Contract, the Information for Bidders, the Proposal, the Authority's acceptance, the Specifications and the Contract Drawings (including written addenda issued over the name of the Chief Engineer), all of which are made part hereof as though herein set forth in full. The Contract as so defined shall constitute the complete and exclusive statement of the terms of the agreement between the parties and the Contract may not be explained or supplemented by course of dealing, usage of trade or course of performance.

The term "days" or "calendar days" in reference to a period of time shall mean consecutive calendar days, Saturdays, Sundays and holidays, included.

The term "construction site" or words of similar import shall mean the Bayonne Bayonne Bridge span above the Kill Van Kull, the approaches thereto and roadways within the vicinity thereof in the States of New York and New Jersey.

"Work" shall mean all structures, equipment, plant, labor, materials (including materials and equipment, if any, furnished by the Authority) and other facilities and all other things necessary or proper for or incidental to performing raising the roadway of the Bayonne Bridge by replacing the bridge's elements except the main span arch and arch abutments, constructing new approaches and toll collection and traffic control systems, constructing new administration, Resident Engineer's office, mechanical/electrical buildings, storage building and related work at the construction site; and "performance of Work" and words of similar import shall mean the furnishing of such facilities and the doing of such things.

"Work required by the Contract Drawings and Specifications in their present form" or words of similar import shall include all Work required by the Specifications in their present form (whether or not shown upon the Contract Drawings), all Work shown upon the Contract Drawings in their present form (whether or not mentioned in the Specifications), and all Work involved in or incidental to the accomplishment of the results intended by the Specifications and Contract Drawings in their present form (whether or not mentioned therein or shown thereon).

"Classified Work" shall mean the items of Work set forth in the Schedule of Unit Prices and shall include any Work hereafter required which is of the same general character as that set forth in any of said items. In determining what is of the same general character, there shall be taken into consideration the provisions for measurement for payment appearing in said clause entitled "Unit Prices", which provisions shall form a part of the items in said Schedules of Unit Prices.

"Unclassified Work" shall mean Work other than Classified Work and Net Cost Work.

"Extra Work" shall mean Work required by the Chief Engineer, Assistant Chief Engineer for Construction, Engineer of Construction or Engineer pursuant to the clause hereof entitled "Extra Work Orders", other than Classified Work, which is in addition to that required by the Contract Drawings and Specifications in their present form.

"Estimated Total for Classified Work" shall mean the result obtained by applying the prices quoted by the Contractor in the Schedule of Unit Prices to the estimated quantities given therein and totaling the results, whether or not such results are correctly shown in the Contractor's Proposal.

"Lump Sum" shall mean the Lump Sum for Unclassified Work quoted by the Contractor in the clause hereof entitled "Contractor's Compensation".

"Contract Drawings" shall mean the Contract Drawings designated in the clause of the Specifications entitled "Contract Drawings" and, except as used in the phrase "Contract Drawings in their present form", shall include any future alterations and revisions of said drawings.

"Shop Drawings" shall mean all drawings, diagrams, illustrations, schedules, including supporting data, which are specifically prepared for this Contract and submitted by the Contractor pursuant to the requirements of the Specifications or the Engineer to illustrate some portion of the Work. The terms "shop drawings", "placing drawings" and "working drawings" are used interchangeably in this Contract.

"Catalog Cuts" shall mean all standard drawings, diagrams, illustrations, brochures, schedules, performance charts and instructions submitted by the Contractor pursuant to the requirements of the Specifications or the Engineer to illustrate some portion of the Work.

"Director of Procurement" shall mean the Director of Procurement of the Authority for the time being, or her successor in duties, acting either personally or through her duly authorized representatives acting within the scope of the particular authority vested in them.

"Chief Engineer" shall mean the Chief Engineer of the Authority for the time being, or his successor in duties, acting personally.

"Engineer" shall mean the Chief Engineer, acting either personally or through his duly authorized representatives acting within the scope of the particular authority vested in them.

"Assistant Chief Engineer for Construction" shall mean the Assistant Chief Engineer for Construction of the Authority for the time being, or his successor in duties, acting personally.

"Engineer of Construction" shall mean the designated Engineer of Construction for the facility at which the Work is being performed or his successor in duties, acting personally.

"Inspector" shall mean any representative of the Engineer designated by him as Inspector and acting within the scope of the particular authority vested in him.

The term "permanent construction" shall include all construction, installation, structures, equipment and materials (including materials and equipment, if any, furnished by the Authority) to be constructed, installed or left by the Contractor at or about the construction site (or elsewhere in the possession of the Authority) after the completion of the Work (whether or not they are yet delivered or installed), even though they are subsequently to be removed by others. The terms, "permanent installation", "permanent structure", "permanent materials", and words of similar import shall have the same meaning as the term "permanent construction".

"Subcontractor" shall mean anyone who performs Work (other than or in addition to the furnishing of materials, plant or equipment) at or about the construction site, directly or indirectly for or in behalf of the Contractor (and whether or not in privity of contract with the Contractor), but shall not include any person who furnished merely his own personal labor or his own personal services or who performs Work which consists only of the operation of construction equipment of which he is the lessor.

"Materialman" shall mean anyone who furnishes materials, plant or equipment to the Contractor or any subcontractor for use at or about the construction site in the performance of Work.

"Materialman" or "subcontractor", however, shall exclude the Contractor or any subsidiary or parent of the Contractor or any person, firm or corporation which has a substantial interest in the Contractor or in which the Contractor or the parent or the subsidiary of the Contractor, or an officer or principal of the Contractor or of the parent or the subsidiary of the Contractor has a substantial interest, provided, however, that for the purpose of the clause hereof entitled "Assignments and Subcontracts" the exclusion in this paragraph shall not apply to anyone but the Contractor himself.

"Workingman" or "workman" shall mean any employee of the Contractor or of a subcontractor who performs personal labor or personal services at the construction site.

"Notice" shall mean a written notice.

"Net Cost" shall mean the amount(s) computed by the Engineer in accordance with the clause in the Form of Contract entitled "Net Cost".

Whenever they refer to the Work or its performance, "directed", "required", "permitted", "ordered", "designated", "prescribed" and words of similar import shall mean directed, required permitted, ordered, designated or prescribed by the Engineer; and "approved", "acceptable", "satisfactory" and words of similar import shall mean approved by or acceptable or satisfactory to the Engineer; and "necessary", "reasonable", "proper", "correct" and words of similar import shall mean necessary, reasonable, proper or correct in the judgment of the Engineer.

Whenever "including", "such as" or words of similar import are used, the specific things thereafter enumerated shall not limit the generality of the things preceding such words.

22. GENERAL AGREEMENT

The Contractor agrees to perform raising the roadway of the Bayonne Bridge by replacing the bridge's elements except the main span arch and arch abutments, constructing new approaches and toll collection and traffic control systems, constructing new administration and Resident Engineer's office, mechanical/electrical buildings, storage building and related work at the construction site and to furnish all structures, equipment, plant, labor, materials and other facilities and to do all other things necessary or proper therefor or incidental thereto, all in strict accordance with the Contract Drawings and Specifications and any future changes therein; and the Contractor further agrees to assume and perform all other duties and obligations imposed upon him by this Contract.

The Authority agrees to pay to the Contractor and the Contractor agrees to accept from the Authority, in full consideration for the performance by the Contractor of his duties and obligations under this Contract and the whole thereof, a compensation provided for in the chapter of the Form of Contract entitled "Compensation and Payments" and such compensation only, subject only to the express provisions of this Contract specifically setting forth actual, defined additions to or deductions from such compensation.

This Contract is one entire contract for the accomplishment of the results and the doing of the things above specified and is not separable. Similarly, the Contractor's compensation is one entire compensation for entire performance on his part.

The enumeration in this Form of Contract and in the Specifications of particular things to be furnished or done at the Contractor's expense, or without cost or expense to the Authority without additional compensation to the Contractor shall not be deemed to imply that only things of a nature similar to those enumerated shall be so furnished and done, but the Contractor shall perform all Work as required, without other compensation than that specifically provided, whatsoever changes may be made in the Contract Drawings and Specifications whatsoever Work may be required in addition to that required by the Contract Drawings and Specifications in their present form, and whatsoever obstacles or unforeseen conditions may arise or be encountered.

23. AUTHORITY ACCESS TO RECORDS

The Authority shall have access during normal business hours to all records and documents of the Contractor relating to any amounts for which the Contractor has been compensated, or claims he should be compensated, by the Authority by payment determined on any basis other than by payment of a lump sum or unit price amount agreed upon in writing by the Contractor and the Authority; provided, however, such access shall extend to certified payroll records as described in the clause of the Form of Contract entitled "Prevailing Rate of Wage" regardless of the method by which the Contractor is compensated under this Contract. The Contractor shall obtain for the Authority similar access to similar records and documents of subcontractors. Such access shall be given or obtained both before and within a period of three years after Final Payment to the Contractor; provided, however, that if within the aforesaid three year period the Authority has notified the Contractor in writing of a pending claim by the Authority under or in connection with this Contract to which any of the aforesaid records and documents of the Contractor or of his subcontractors relate either directly or indirectly, then the period of such right of access shall be extended to the expiration of 6 years from the date of Final Payment with respect to the records and documents involved.

Upon request of the Authority, the Contractor shall furnish or provide access to the federal Form I-9 (Employment Eligibility Verification) for each individual performing Work under this Contract, including both citizens and non-citizens.

No provision in this Contract giving the Authority a right of access to records and documents is intended to impair or affect any right of access to records and documents which the Authority would have in the absence of such provision.

24. RENTAL OF CONSTRUCTION EQUIPMENT

With respect to the performance of Work in the State of New York:

The rental of construction equipment shall be subject to all applicable New York sales and use taxes notwithstanding the Authority's status as an Exempt Organization in New York, as such term is defined in section eleven hundred sixteen of the New York State Sales and Compensating Use Tax Act.

The Contractor shall indemnify the Authority against any claim of any kind whatsoever made against the Authority by a lessor of construction equipment and the Contractor assumes the risk of all claims against him by any lessor of construction equipment, including in both cases, claims in connection with a subcontractor.

25. EXEMPTION FROM NEW JERSEY SALES AND USE TAXES

With respect to the performance of Work in the State of New Jersey, the tax laws of the State of New Jersey (New Jersey Sales and Tax Act, P.L. 1966, c. 30 (§54:32B et seq.)) exempt from New Jersey sales and use taxes "[r]eceipts from sales made to contractors or repairmen of materials, supplies, or services for exclusive use in erecting structures or building on, or otherwise improving, altering or repairing real property of...[o]rganizations described in subsections (a) and (b) of section 9 of the "Sales and Use Tax Act"...that are exempt from the tax imposed [thereunder]."[21] In order to qualify for this exemption, the Contractor shall comply with the rules and regulations prescribed by the State of New Jersey Division of Taxation. The attention of Contractor is directed to Form ST-13, Contractor's Exempt Purchase of Certificate, available on the State of New Jersey Division of Taxation's website: www.state.nj.us/treasury/.

The Authority is an organization of the type described in subsection (a)(1) of section 9 of the Sales and Use Tax Act.[22]

In view of the foregoing, the Contractor shall not include in his price(s) any amounts for sales and use taxes on materials, supplies, or services for use in the performance of improvements, alterations, or repairs at the construction site. However, receipts for the rental of equipment to be used at the construction site may be subject to sales and use taxes, and therefore, the Contractor should include in his price(s) any amounts for sales and use taxes on rental of equipment.

If (i) any claim is made against the Contractor by the State of New Jersey for such sales or compensating use taxes, or (ii) any claim is made against the Contractor by a materialman or a subcontractor on account of a claim against such materialman or subcontractor by the State of New Jersey for such sales or compensating use taxes, then the Authority will reimburse the Contractor in an amount equal to the amount of such tax required to be paid in accordance with the requirements of law, provided that:

A. the Contractor and any subcontractor, has or have complied with the rules and regulations of the State of New Jersey Division of Taxation relating to the procedure by which the tax exemption may be claimed, and has or have filed all the forms and certificates required by applicable laws, rules and regulations in connection with such exemption; and

B. The Authority is afforded the opportunity before any payment of tax is made, to contest said claim in the manner and to the extent that the Authority may choose and to settle or satisfy said claim, and such attorney as the Authority may designate is authorized to act for the purpose of contesting, settling and satisfying said claim; and

C. the Contractor and any subcontractor, has given immediate notice to the Authority of any such claim, has or have cooperated with the Authority and its designated attorney in contesting said claim, and has or have furnished promptly to the Authority and said attorney all information and documents necessary or convenient for contesting said claim, said information and documents to be preserved for six years after the date of Final Payment or longer if such a claim is pending or threatened at the end of such six years.

If the Authority elects to contest any such claim, it will bear the expense of such contest.

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[21] N.J.S.A. 54:32B-8.22.

[22] N.J.S.A. 54:32B-9.

26. EXEMPTION FROM NEW YORK STATE AND NEW YORK CITY SALES TAXES

With respect to the performance of Work in the State of New York:

The attention of the Contractor and his subcontractors and materialmen, if any, is directed to the New York State and New York City tax laws, as they apply to the Work of this Contract, and the New York State Department of Taxation and Finance (herein called the "Department") Form ST-120.1, Contractor Exempt Purchase Certificate, available on the Department's website: www.tax.ny.gov/forms/.

Subdivision (a) of section eleven hundred fifteen of the New York State Sales and Compensating Use Tax Act (herein called the "Act") provides contractors with an exemption from sales and compensating use taxes (herein called "Sales Tax") for, among other things:

> (15) Tangible personal property sold to a contractor, subcontractor or repairman for use in erecting a structure or building of an organization described in subdivision (a) of section eleven hundred sixteen, or adding to, altering or improving real property, property or land of such an organization, as the terms real property, property or land are defined in the real property tax law; provided, however, no exemption shall exist under this paragraph unless such tangible personal property is to become an integral component part of such structure, building or real property."

The Authority is an exempt organization of the type described in subdivision (a) of section eleven hundred sixteen of the Act.

In view of the foregoing, the Contractor should not include in his price(s) any amounts for Sales Tax on such tangible personal property (herein called "Exempt Purchases"). The Contractor shall execute and provide his vendors with a properly completed Form ST-120.1 when effectuating such Exempt Purchases.

As provided in the clause hereof entitled "Rental of Construction Equipment", the Contractor's rental of equipment and the Contractor's purchases of tangible personal property that does not become an integral component part of the permanent construction are, in all cases, subject to Sales Tax.

If (i) any claim is made against the Contractor by the State of New York or City of New York for such Sales Tax on Exempt Purchases, or (ii) any claim is made against the Contractor by a materialman or a subcontractor on account of a claim against such materialman or subcontractor by the State of New York or City of New York for such Sales Tax on Exempt Purchases, then the Authority will reimburse the Contractor in an amount equal to the amount of such tax required to be paid in accordance with the Act, provided that:

1.) The Contractor's liability for such Sales Tax is caused solely by a finding by the Department that the Authority is not an Exempt Organization of the type described in subdivision (a) of section eleven hundred sixteen of the Act; and

2.) the Contractor, or the Contractor and any such subcontractor, as the case may be, have complied with such rules and regulations as may have been promulgated relating to the claiming of the exemption from such Sales Tax and have furnished to vendors all the forms and certificates required by the applicable laws, rules and regulations in connection therewith; and

3.) the Authority is afforded the opportunity before any payment of tax is made, to contest said claim in the manner and to the extent that the Authority may choose and to settle or satisfy said claim and such attorney as the Authority may designate is authorized to act for the purpose of contesting, settling and satisfying said claim; and

4.) the Contractor, or the Contractor and any such subcontractor, as the case may be, give immediate notice to the Authority of any such claim, cooperate with the Authority and its designated attorney in contesting said claim and furnish promptly to the Authority and said attorney all information and documents necessary or convenient for contesting said claim, said information and documents to be preserved for six years after the date of Final Payment or longer if such a claim is pending or threatened at the end of such six years.

If the Authority elects to contest any such claim, it will bear the expense of such contest.

27. PERFORMANCE AND PAYMENT BOND

If the Authority shall in its sole discretion so elect at the time of accepting the Contractor's Proposal, the Contractor shall furnish a bond for the faithful performance of all obligations imposed upon him by the Contract and also for the payment of all lawful claims of subcontractors, materialmen and workmen arising out of the performance of the Contract. Such bond shall be in the form bound herewith entitled, "Performance and Payment Bond", shall be in a penal sum equal to the Total and such bond shall be signed by one or more sureties[23] satisfactory to the Authority. The bond may be executed on a separate copy of such form not physically attached to this Contract booklet. In any case, both the form of bond bound herewith and any unattached executed copy thereof shall form a part of this Form of Contract as though herein set forth in full.

At any time after the opening of Proposals, the Authority may give notice to one or more bidders to advise the Authority as to the names of their proposed sureties. Within forty-eight hours thereafter each bidder so notified shall so advise the Authority. The giving of such notice to a bidder shall not be construed as an acceptance of his Proposal, and omission to give such notice shall not be construed as an election by the Authority not to require a bond.

If the Authority elects to require the Contractor to furnish a bond, he shall deliver such bond to the Authority within seven days after receipt by him of the acceptance of his Proposal, and the sureties thereon shall be as proposed by him, provided, that if the Authority has theretofore given notice to him that his proposed sureties or any of them are not satisfactory, the bond shall be executed by other sureties satisfactory to the Authority.

The Authority shall give notice to the Contractor within ten (10) days after receipt of the Performance and Payment Bond as to whether or not such bond is satisfactory.

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23 Sureties must be corporations (commonly known as "surety companies"), authorized to do business as sureties in the state(s) in which the construction site is located, whose names appear on the current list of the Treasury Department of the United States in effect at the time of submission of the Performance and Payment Bond to the Authority as acceptable as sureties to the Treasury Department. In addition, the aggregate underwriting limitations on any one risk as set forth in the aforementioned list of the Treasury Department of the sureties shall equal or exceed the penal sum of the Performance and Payment Bond.

In the event of a default by the Contractor in his obligation to furnish a satisfactory bond within seven (7) days after he received an acceptance of his Proposal, such default shall entitle the Authority in its discretion to terminate this Contract at any time within forty-five (45) days after the acceptance of the Proposal, without any liability on the part of the Authority. Inasmuch as the damages to the Authority resulting from a termination by it upon the failure of the Contractor to furnish a satisfactory bond will include items whose accurate amount will be difficult or impossible to compute, such damages shall be liquidated in the sum of the following amounts:

A. The excess, if any, of the Total in the Proposal finally accepted over that in the Proposal of the Contractor; and

B. The expense of such new advertisement of the Contract, if any, as may be deemed necessary by the Authority; and

C. The sum of $0 for each day after the receipt by the Contractor of the acceptance of his Proposal that the performance of the Contract is not commenced by reason of the failure of the Contractor to furnish the required bond.

In the recovery of the damages above specified, the Authority may proceed against the sum represented by the certified check deposited with it or against the Bid Bond and take such other action as it may deem best in the public interest.

If the Contractor furnishes a bond in accordance with the requirements of the Authority under this numbered clause, the Authority shall reimburse the Contractor for the net amount actually paid by him to the surety or sureties as the premium on such bond. The Contractor shall deliver to the Engineer receipts from the surety or sureties evidencing such payment and the amount thereof. Within fifteen days after receipt of such evidence satisfactory to the Engineer, the Authority shall pay to the Contractor by check the amount provided in this numbered clause.

If at any time the Authority shall be or become dissatisfied with any surety or sureties then upon any bond furnished in accordance with the requirements of the Authority, or if for any other reason such bond shall cease to be adequate security to the Authority, the Contractor shall, within five days after notice from the Authority so to do, substitute a new bond in such form and sum and signed by such other sureties as may be necessary in the opinion of the Authority to constitute adequate security.

Total

CHAPTER II

COMPENSATION AND PAYMENTS

28. CONTRACTOR'S COMPENSATION[24]

The Contractor's entire compensation under the Contract shall be the sum of the following amounts:

A. An amount equal to the actual Total for Classified work computed by the Engineer from the actual quantities of the Work performed.

B. An amount representing the Lump Sum for Unclassified Work of

Six hundred seventy million, sixty-three thousand, nine hundred ninety Dollars

zero Cents

(amount written in words)

($ 670,063,990.00)[25]

(amount written in figures)

C. An amount equal to Twelve and no hundredths percent[26]

(Percentage written in words)

(12 %)

(Percentage written in figures)

of the amount of the Net Cost of the Work as identified in D. below.

D. An amount equal to the Net Cost of the Work computed by the Engineer in accordance with the clause entitled "Net Cost".

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:

[24] In addition to the insertions hereof, fill in the table and perform the computations stipulated in the clause of the Information for Bidders entitled "Comparison of Proposals".

[25] Insert the amount written in words and figures. In case of discrepancy between the amount written in words and the amount written in figures, the amount written in words shall control.

[26] Insert the percentage in numbers and in writing to two decimal places (e.g. Eight and No Hundreths Percent – 8.00%). In case of discrepancy between percentages quoted in writing and those quoted in figures, the writing shall control.

E. The following amounts:

1.) Amounts to be computed in accordance with the clause entitled "Compensation for Extra Work.

2.) Amounts other than those specified in this clause that are specifically provided for elsewhere in this Contract setting forth actual defined additions to or deductions from such compensation.

3.) Amounts to be agreed upon for the preparation of working drawings and catalog cuts pursuant to the Section of the Specifications entitled "Shop Drawings, Catalog Cuts and Samples" for working drawings and catalog cuts required by the Engineer for Work to be compensated in accordance with the clause of the Form of Contract entitled "Net Cost".

29. UNIT PRICES

The following Schedule of Unit Prices for Classified Work does not constitute an outline of the Work required by the Contract Drawings and Specifications in their present form, but is merely a list of all the items of Classified Work to be used in computing the Contractor's compensation insofar as it is based upon Classified Work, together with the rates at which such compensation will be computed. In the case of each item of Classified Work, the Work performed will be measured and the Contractor's compensation will be computed as hereinafter provided in this numbered clause. In case of discrepancy between the prices quoted in writing and those quoted in figures, the writing shall control.

The estimated quantities are given solely as a basis for the computation of the Total. The Authority makes no representation as to what the actual quantities will be and shall not be held responsible even though the estimated quantities are not even approximately correct. Insofar as the Contractor's compensation is based upon Classified Work, it will be computed from the actual quantities of Work performed, whether greater or less than the estimated quantities.

Bid Items:
Classified
Work

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
			Figures	
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Unit Prices	Amounts[27]
1	2,885 LF	6-FT O.D. DRILLED SHAFTS IN SOIL, PER LINEAR FOOT. Two thousand nine hundred DOLLARS zero CENTS	2,900.00	8,366,500.00
2	2,552 LF	5.5-FT O.D. DRILLED SHAFT ROCK SOCKET, PER LINEAR FOOT. Two thousand four hundred DOLLARS zero CENTS	2,400.00	6,124,800.00
3	4,336 LF	11.875-IN O.D. MICRO-PILE IN SOIL, PER LINEAR FOOT. Three hundred DOLLARS zero CENTS	300.00	1,300,800.00
4	2,770 LF	9.5-IN O.D. MICRO-PILE ROCK SOCKET, PER LINEAR FOOT. Two hundred ten DOLLARS zero CENTS	210.00	581,700.00
5	2,400 EA	MONITORING AND REPORTING FOR MANHOLE RIMS, PER EACH. One hundred twenty DOLLARS zero CENTS	120.00	288,000.00
6	40 EA	FURNISHING AND INSTALLING SURFACE SETTLEMENT MONITORING POINTS, PER EACH. One thousand three hundred fifty DOLLARS zero CENTS	1,350.00	54,000.00
7	960 EA	MONITORING AND REPORTING FOR SURFACE SETTLEMENT MONITORING POINTS, PER EACH. Two hundred DOLLARS zero CENTS	200.00	192,000.00
8	327 LF	FURNISHING AND INSTALLING DEEP BENCHMARKS, PER LINEAR FOOT. Three hundred fifty DOLLARS zero CENTS	350.00	114,450.00

27 The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts[27]
9	192 EA	MONITORING AND REPORTING FOR DEEP BENCHMARKS, PER EACH. One thousand five hundred DOLLARS zero CENTS	1,500.00	288,000.00
10	432 LF	FURNISHING AND INSTALLING OBSERVATION WELLS, PER LINEAR FOOT. Two hundred twenty-five DOLLARS zero CENTS	225.00	97,200.00
11	480 EA	MONITORING AND REPORTING FOR OBERVATION WELLS, PER EACH. Five hundred DOLLARS zero CENTS	500.00	240,000.00
12	216 EA	FURNISHING AND INSTALLING HIGH PRECISION OPTICAL SURVEY PRISMS. Three thousand DOLLARS zero CENTS	3,000.00	648,000.00
13	5,184 EA	MONITORING AND REPORTING FOR HIGH PRECISION OPTICAL SURVEY PRISMS, PER EACH. One hundred DOLLARS zero CENTS	100.00	518,400.00
14	96 EA	FURNISHING AND INSTALLING TILTMETERS, PER EACH. Three thousand two hundred DOLLARS zero CENTS	3,200.00	307,200.00
15	2,304 EA	MONITORING AND REPORTING FOR TILTMETERS, PER EACH. Eighty DOLLARS zero CENTS	80.00	184,320.00
16	40 EA	FURNISHING AND INSTALLING VIBRATION MONITORING LOCATIONS. Five thousand DOLLARS zero CENTS	5,000.00	200,000.00

[27] The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts[27]
17	960 EA	MONITORING AND REPORTING FOR VIBRATION MONITORING LOCATIONS, PER EACH. Three hundred twenty DOLLARS zero CENTS	320.00	307,200.00
18	150 LF	FURNISHING AND INSTALLING VIBRATING WIRE PIEZOMETERS, PER LINEAR FOOT. Four hundred thirty DOLLARS zero CENTS	430.00	64,500.00
19	144 EA	MONITORING AND REPORTING FOR VIBRATING WIRE PIEZOMETERS, PER EACH. One hundred seventy-five DOLLARS zero CENTS	175.00	25,200.00
20	14 EA	FURNISHING AND INSTALLING STRUCTURAL MONITORING POINTS, PER EACH. Four hundred DOLLARS zero CENTS	400.00	5,600.00
21	336 EA	MONITORING AND REPORTING FOR STRUCTURAL MONITORING POINTS, PER EACH. Eight hundred fifty DOLLARS zero CENTS	850.00	285,600.00
22	150 EA	FURNISHING AND INSTALLING GRID CRACK GAGES, PER EACH. One hundred forty DOLLARS zero CENTS	140.00	21,000.00
23	3,600 EA	MONITORING AND REPORTING FOR GRID CRACK GAGES, PER EACH. Ten DOLLARS zero CENTS	10.00	36,000.00

27 The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
			Unit Prices	Amounts[27]
24	8 EA	FURNISHING AND INSTALLING ELEVATION SETTLEMENT PLATFORM, PER EACH. Two thousand one hundred fifty DOLLARS zero CENTS	2,150.00	17,200.00
25	192 EA	MONITORING AND REPORTING FOR ELEVATION SETTLEMENT PLATFORM, PER EACH. Two hundred fifty DOLLARS zero CENTS	250.00	48,000.00
26	4 EA	OSTERBERG CELL LOAD TEST SHAFT INSTALLATION AND LOAD TEST SET UP, PER EACH. Three hundred thousand DOLLARS zero CENTS	300,000.00	1,200,000.00
27	12 24-HR DAYS	MANNING THE OSTERBERG CELL LOAD TESTS, PER 24 HR. DAY. Twelve thousand DOLLARS zero CENTS	12,000.00	144,000.00
28	4 EA	MICRO-PILE LOAD TEST PILE INSTALLATION AND LOAD TEST SET UP, PER EACH. One hundred thousand DOLLARS zero CENTS	100,000.00	400,000.00
29	12 24-HR DAYS	MANNING THE MICRO-PILE LOAD TESTS, PER 24 HR. DAY. Two thousand DOLLARS zero CENTS	2,000.00	24,000.00
30	2 EA	MOBILIZATION FOR EXPLORATORY BORINGS, PER EACH. Two thousand DOLLARS zero CENTS	2,000.00	4,000.00
31	1,800 LF	DRILLING EXPLORATORY BORINGS, PER LINEAR FOOT. Sixty DOLLARS zero CENTS	60.00	108,000.00

[27] The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures: Unit Prices	Figures: Amounts[27]
32	360 EA	EXPLORATORY BORING SPLIT SPOON SOIL SAMPLES, PER EACH. Seventy-five DOLLARS zero CENTS	75.00	27,000.00
33	1,500 LF	DRILLING EXPLORATORY BORING ROCK CORE SAMPLES. Seventy-five DOLLARS zero CENTS	75.00	112,500.00
34	4,710 LF	ARCH ABUTMENT REPAIR: TYPE 1, PER LINEAR FOOT. Ninety DOLLARS zero CENTS	90.00	423,900.00
35	2,400 LF	ARCH ABUTMENT REPAIR: TYPE 2, PER LINEAR FOOT. Ninety DOLLARS zero CENTS	90.00	216,000.00
36	700 SF	ARCH ABUTMENT REPAIR: TYPE 3, PER SQUARE FOOT. Two hundred fifty DOLLARS zero CENTS	250.00	175,000.00
37	700 SF	ARCH ABUTMENT REPAIR: TYPE 4, PER SQUARE FOOT. Four hundred seventy five DOLLARS zero CENTS	475.00	332,500.00
38	80 LF	6-FT O.D. DEMONSTRATION DRILLED SHAFTS IN SOIL, PER LINEAR FOOT. One thousand six hundred DOLLARS zero CENTS	1,600.00	128,000.00

[27] The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts[27]
39	44 LF	5.5-FT O.D. DEMONSTRATION DRILLED SHAFT ROCK SOCKET, PER LINEAR FOOT. Two thousand five hundred DOLLARS zero CENTS	2,500.00	110,000.00
40	183,000 LBS	LOWER CHORD BRACING REPAIRS, PER LB. Four DOLLARS zero CENTS	4.00	732,000.00
41	295,000 LBS	SWAY BRACING REPAIRS, PER LB. Five DOLLARS zero CENTS	5.00	1,475,000.00
42	3,200 LBS	MISCELLANEOUS STEEL REPAIRS, PER LB. Sixteen DOLLARS zero CENTS	16.00	51,200.00
43	8 EACH	REPLACE ARCH CHORD ACCESS HATCHES, PER EACH. One thousand two hundred DOLLARS zero CENTS	1,200.00	9,600.00
44	26 EACH	RUST PACK REPAIR, PER EACH. Five thousand DOLLARS zero CENTS	5,000.00	130,000.00
45	98 EACH	REPAIR EXISTING TESTING/COUPON HOLES, PER EACH. One thousand DOLLARS zero CENTS	1,000.00	98,000.00
ESTIMATED TOTAL FOR CLASSIFIED WORK[28]				

27 The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

28 The Estimated Total for Classified Work shall be computed by totaling the amounts inserted in the "Amounts" column.

The following provisions are applicable to the Schedule of Unit Prices for Classified Work. The quantity for payment described in the following provisions shall be the quantity of Classified Work furnished, installed, performed and/or placed in accordance with the Specifications, as shown on the Contract Drawings and where ordered by the Engineer.

No quantity of work will be included under more than one item of Classified Work.

In the case of Item No. 40 (Lower Chord Bracing Repairs), the quantity for payment shall be the pounds of structural steel furnished and installed to accomplish the repairs at various locations. The structural steel includes cover plates, cheese plates, perforated plates and batten plates. The final quantity and locations of these repairs will be determined by the Engineer during the construction and further inspection of the arch structure. Local demolition, rivet removal and bolting will be considered incidental to the work.

In the case of Item No. 41 (Sway Bracing Repairs), the quantity for payment shall be the pounds of structural steel furnished and installed to accomplish the repairs at various locations. The structural steel includes cover plates, cheese plates and perforated plates. The final quantity and locations of these repairs will be determined by the Engineer during the construction and further inspection of the arch structure. Local demolition, rivet removal and bolting will be considered incidental to the work.

In the case of Item No. 42 (Miscellaneous Steel Repairs), the quantity for payment shall be the pounds of structural steel furnished and installed to accomplish the repairs at various locations. The structural steel includes batten plates, lacing angles and diaphragm plates. The final quantity and locations of these repairs will be determined by the Engineer during the construction and further inspection of the arch structure. Local demolition, rivet removal and bolting will be considered incidental to the work.

In the case of Item No. 43 (Replace Arch Chord Access Hatches), the quantity for payment shall be the number of chord access hatches removed and replaced in accordance with the details shown on the Contract Drawings.

In the case of Item No. 44 (Rust Pack Repair), the quantity for payment shall be the number of locations identified as Repair Type A2. The work includes rust removal, base metal cleaning, painting and application of sealant.

In the case of Item No. 45 (Repair Existing Testing/Coupon Holes), the quantity for payment shall be the actual number of holes repaired in accordance with the details shown on the Contract Drawings. The work includes the furnishing and installing structural steel and bolts in accordance with the details noted for Repair M4.

In the case of Item No. 1 (6-ft O.D. Drilled Shafts In Soil), the quantity for payment shall be the number of linear feet of drilled shafts installed through soil to the actual top of Competent Rock elevations as defined in the Specification No. 02378. The length of payment will be measured by the Engineer from the top of Competent Rock elevation to the cutoff elevation. The length of any drilled shafts which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 2 (5.5-ft O.D. Drilled Shaft Rock Socket), the quantity for payment shall be the number of linear feet of drilled shaft rock sockets installed in Competent Rock to the final tip elevation of the drilled shaft, as defined in the Specification No. 02378. The length of payment will be measured by the Engineer from the top of Competent Rock elevation (see item CL-1) to the specified final tip elevation for the drilled shaft. The length of any drilled shaft rock sockets which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 3 (11.875-in O.D. Micro-pile In Soil), the quantity for payment shall be the number of linear feet of micro-piles installed through soil to the actual top of Competent Rock elevations as defined in the Specification No. 02376. The length of payment will be measured by the Engineer from the top of Competent Rock elevation to the cutoff elevation. The length of any micro-piles which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 4 (9.5-in O.D. Micro-pile Rock Socket), the quantity for payment shall be the number of linear feet of micro-pile rock sockets installed in Competent Rock to the final tip elevation for the micropile, as defined in the Specification No. 02376. The length of payment will be measured by the Engineer from the top of Competent Rock Elevation (see item CL-3) to the specified final tip elevation for the micropile. The length of any micro-pile rock sockets which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 5 (Monitoring and Reporting for Manhole Rims), the quantity for payment shall be the number of manhole rims monitored and reported for settlements each month, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212 as determined by the Engineer. The quantity of any manhole rims which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 6 (Furnishing and Installing Surface Settlement Monitoring Points), the quantity for payment shall be the number of surface settlement monitoring points installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212 as determined by the Engineer. The quantity of any surface settlement monitoring points which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 7 (Monitoring and Reporting for Surface Settlement Monitoring Points), the quantity for payment shall be the number of surface settlement monitoring points monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any surface settlement monitoring points which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 8 (Furnishing and Installing Deep Benchmarks), the quantity for payment shall be the linear feet of deep benchmarks installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212. The length of payment will be measured by the Engineer from the actual bottom elevation of the deep benchmark (bottom of borehole) to the ground surface. The length of any deep benchmarks which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 9 (Monitoring and Reporting for Deep Benchmarks), the quantity for payment shall be the number of deep benchmarks monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any deep benchmarks which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 10 (Furnishing and Installing Observation Wells), the quantity for payment shall be the linear feet of observation wells installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212. The length of payment will be measured by the Engineer from the actual bottom elevation of the observation wells (bottom of borehole) to the ground surface. The length of any observation wells which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 11 (Monitoring and Reporting for Observation Wells), the quantity for payment shall be the number of observation wells monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any observation wells which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 12 (Furnishing and Installing High Precision Optical Survey Prisms), the quantity for payment shall be the number of high quality prisms installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, as determined by the Engineer . The quantity of any high quality prisms which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 13 (Monitoring and Reporting For High Precision Optical Survey Prisms), the quantity for payment shall be the number of high quality prisms monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any high quality prisms which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 14 (Furnishing and Installing Tiltmeters), the quantity for payment shall be the number of tiltmeters installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212 as determined by the Engineer . The quantity of any tiltmeters which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 15 (Monitoring and Reporting For Tiltmeters), the quantity for payment shall be the number of tiltmeters monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any tiltmeters which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 16 (Furnishing and Installing Vibration Monitoring Locations), the quantity for payment shall be the number of vibration monitoring locations installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, as determined by the Engineer. The quantity of any vibration monitoring locations which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 17 (Monitoring and Reporting for Vibration Monitoring Locations), the quantity for payment shall be the number of vibration monitoring locations monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any vibration monitoring locations which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 18 (Furnishing and Installing Vibrating Wire Piezometers), the quantity for payment shall be the linear feet of vibrating wire piezometers installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212. The length of payment will be measured by the Engineer from the actual bottom elevation of the vibrating wire piezometers (bottom of borehole) to the ground surface. The length of any vibrating wire piezometers which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 19 (Monitoring and Reporting for Vibrating Wire Piezometers), the quantity for payment shall be the number of vibrating wire piezometers monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any vibrating wire piezometers which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 20 (Furnishing and Installing Structural Monitoring Points), the quantity for payment shall be the number of structural monitoring points installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, as determined by the Engineer . The quantity of any structural monitoring points which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 21 (Monitoring and Reporting For Structural Monitoring Points), the quantity for payment shall be the number of structural monitoring points monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any structural monitoring points which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 22 (Furnishing and Installing Grid Crack Gages), the quantity for payment shall be the number of grid crack gages installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212 as determined by the Engineer. The quantity of any crack gages which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 23 (Monitoring and Reporting For Grid Crack Gages), the quantity for payment shall be the number of grid crack gages monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any crack gages which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 24 (Furnishing and Installing Elevation Settlement Platform), the quantity for payment shall be the actual number of elevation settlement platforms installed in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, as determined by the Engineer. The quantity of any elevation settlement platforms which are not installed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 25 (Monitoring and Reporting for Elevation Settlement Platform), the quantity for payment shall be the number of elevation settlement platforms monitored and reported, in accordance with the requirements shown on the Contract Drawings and Specification Section 02212, each month as determined by the Engineer. The quantity of any elevation settlement platforms which are not monitored or reported in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 26 (Osterberg Cell Load Test Set Up), the quantity for payment shall be the number of Osterberg Cell Load Test set up, including installation of the Osterberg Cell load test shafts, in accordance with the requirements shown on the Contract Drawings and Specification Section 02378. The quantity of any Osterberg Cell Load Tests which are not set up in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 27 (Manning the Osterberg Cell Load Tests), the quantity for payment shall be the number of 24-hr days, including any portions of 24-hr days for which the Contractor provides the required manpower and services during the loading and unloading periods of Osterberg Cell Load Tests, in accordance with the requirements shown on the Contract Drawings and Specification Section 02378. . The portion of any 24-hr day for which Osterberg Cell Load Tests are not performed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 28 (Micro-pile Load Test Set Up), the quantity for payment shall be the number of Micro-pile Load Test set up, including installation of the test piles for the micro-pile load tests, in accordance with the requirements shown on the Contract Drawings and Specification Section 02376. The quantity of any Micro-pile Load Tests which are not set up in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 29 (Manning the Micro-pile Load Tests), the quantity for payment shall be the number of 24-hr days, including any portions of 24-hr days for which the Contractor provides the required manpower and services during the loading and unloading periods of Micro-pile Load Tests, in accordance with the requirements shown on the Contract Drawings and Specification Section 02376. The portion of any 24-hr day for which Micro-pile Load Tests are not performed in accordance with the requirements shown on the Contract Drawings and Specifications shall not be included in the quantity for payment.

In the case of Item No. 30 (Mobilization for Exploratory Borings), the quantity for payment shall be the number of times a drill rig with all men, equipment and supplies necessary to perform the required exploratory borings and related work, as the case may be, are completely mobilized at the approximate location of the borings to be performed in a work area as ordered by the Engineer. A move from one location to another within a single work area, without occasion to remove the drill rig and equipment from such work area, except temporarily in the course of such move, shall not be considered as an additional mobilization for payment or as cause for any other separate payment. As used herein "Work Area" shall mean that area specified by the Engineer in his respective orders to mobilize.

In the case of Item No. 31 (Drilling Exploratory Borings), the quantity for payment shall be the number of linear feet of boring actually drilled, in accordance with Specification Sections 02376 and 02378, measured from ground elevation to the bottom of the hole or to the top of rock, as the case may be. The quantity of any exploratory borings which are not drilled in accordance with the requirements in the Specification Sections 02376 and 02378 shall not be included in the quantity for payment.

In the case of Item No. 32 (Exploratory Boring Split Spoon Soil Samples), the quantity for payment shall be the number of split spoon soil samples taken and delivered to the Authority, in accordance with requirements in Specification Sections 02376 and 02378. The quantity of any split spoon soil samples which are not taken or delivered to the Authority in accordance with Specification Sections 02376 and 02378 shall not be included in the quantity for payment.

In the case of Item No. 33 (Drilling Exploratory Boring Rock Core Samples), the quantity for payment shall be the linear feet of rock core samples drilled, obtained and delivered to the Authority, measured from the top of rock (see item CL-31) to the bottom of borehole, in accordance with requirements in Specification Sections 02376 and 02378. The quantity of any rock core samples which are not drilled, obtained, or delivered to the Authority in accordance with Specification Sections 02376 and 02378 shall not be included in the quantity for payment.

In the case of Item No. 34 (ARCH ABUTMENT REPAIR: TYPE 1), the quantity for payment shall be linear feet of cracks sealed in accordance with the requirements of Specification Section 03734. The length will be determined by measuring the straight line distance between the beginning point and ending point of each filled crack.

In the case of Item No. 35 (ARCH ABUTMENT REPAIR: TYPE 2), the quantity for payment shall be linear feet of cracks sealed in accordance with the requirements of Specification Section 03734. The length will be determined by measuring the straight line distance between the beginning point and ending point of each filled crack.

In the case of Item No. 36 (ARCH ABUTMENT REPAIR: TYPE 3), the quantity for payment shall be square feet of spalls repaired in accordance with the requirements of Specification Section 03730. The area will be determined by measuring the limits of saw-cut required to perform the repair.

In the case of Item No. 37 (ARCH ABUTMENT REPAIR: TYPE 4), the quantity for payment shall be square feet of spalls repaired in accordance with the requirements of Specification Section 03730. The area will be determined by measuring the limits of saw-cut required to perform the repair.

In the case of Item No. 38 (6-FT O.D. DEMONSTRATION DRILLED SHAFTS IN SOIL), the quantity for payment shall be the number of linear feet of demonstration drilled shafts installed through soil to the actual top of Competent Rock elevations as defined in the Specification No. 02378. The length of payment will be measured by the Engineer from the top of Competent Rock elevation to the cutoff elevation. The length of any demonstration drilled shafts which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

In the case of Item No. 39 (5.5-FT O.D. DEMONSTRATION DRILLED SHAFT ROCK SOCKET), the quantity for payment shall be the number of linear feet of demonstration drilled shaft rock sockets installed in Competent Rock to the final tip elevation of the demonstration drilled shaft, as defined in the Specification No. 02378. The length of payment will be measured by the Engineer from the top of Competent Rock elevation (see item 38) to the specified final tip elevation for the demonstration drilled shaft. The length of any demonstration drilled shaft rock sockets which do not conform to the requirements of the Contract Drawings and Specifications shall not be included in the length for payment.

30. NET COST

A. Net Cost shall be determined by the Engineer in accordance with the following provisions and shall include the following amounts as applicable:

1.) In the case of labor performed by the Contractor personally, or by a subcontractor approved by the Authority as required by the clause herein entitled "Approvals of Subcontracts, Purchases, Rentals and Sales" which is necessary for performance of Work required hereunder, an amount equal to the actual cost in money of the labor required for the Work.

a. As used in this numbered clause "labor" means on site labor necessarily performed at the construction site by the foremen, surveyors, laborers, mechanics, timekeepers, and other employees directly employed at the construction site[29] by the Contractor or an approved subcontractor, and "cost of labor" means the wages actually paid and received by such employees engaged in operations under this Contract plus a proper proportion of (i) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligations upon the basis of such wages, (ii) vacation allowances which the employer actually pays to salaried employees (the employees to be included under this subsection ((ii)) being subjected to the approval of the Engineer), and (iii) taxes actually paid by the employer pursuant to law upon the basis of such wages.

b. No inclusion in Net Cost shall be made for any salaried employee whose salary and whose employment on the job has not been approved in advance by the Engineer in writing. No inclusion in Net Cost shall be made for any wage in excess of prevailing wage rates in the state in which the work is being performed without prior written approval of the Engineer. In addition to the foregoing, no inclusion in Net Cost shall be made for overtime (other than the straight time wages) unless approved in advance by the Engineer in writing; or for preparation of working drawings, catalog cuts or the design of temporary structures, if any.

2.) In the case of permanent, temporary or consumable materials necessary for performance of Work required hereunder, an amount equal to the actual amounts paid by the Contractor or a subcontractor approved by the Authority as required by the clause herein entitled "Approvals of Subcontracts, Purchases, Rentals and Sales" for such material (less salvage value of temporary materials and any purchased tools and purchased equipment as provided in the immediately following sentence; such salvage value shall be as determined by the Engineer at the conclusion of the Work) plus the reasonable cost of inspection, testing, transportation, storage and handling of such materials all in strict conformity with purchase orders approved in writing by the Engineer. As used herein, materials shall include temporary materials (including temporary utility services), consumable items (including temporary sanitary facilities), tools (excluding non-powered hand tools) and equipment purchased if directed by the Engineer where the Engineer has determined that the Contractor will not be compensated for the use of such tools and equipment under subparagraph 4 below.

3.) If the Contractor is the manufacturer or producer of materials necessary for the performance of the Work, the reasonable cost to the Contractor of the manufacture, production, inspection, testing, transportation, storage and handling of such materials, provided said materials are manufactured or produced after the written approval of the Engineer is obtained.

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[29] In the case of labor performed partially at the construction site and partially away from such site, the Engineer shall determine which portion of such labor is classifiable as "labor" as that therm is used in this numbered clause.

4.) For rental of equipment (excluding non-powered hand tools) or construction aids (such as scaffolds, ladders, stairs, ramps, runways, platforms, railing, chutes and other such facilities) whether owned or not owned by the Contractor or a subcontractor an amount computed pursuant to the clause herein entitled "Computation of Rental for Construction Equipment", for equipment actually and necessarily used by the Contractor or a subcontractor, approved by the Authority as required by the clause hereof entitled "Approvals of Subcontracts, Purchases, Rentals and Sales" for the performance of the Work required hereunder.

5.) An amount equal to the actual cost in money, as approved by the Engineer in writing, expended by the Contractor or a subcontractor approved by the Authority as required by the clause herein entitled "Approvals of Subcontracts, Purchases, Rentals and Sales", for procuring bonds or permits approved by the Engineer as necessary for the performance of the Work required hereunder.

B. Exclusions

In computing the Net Cost of the Work, no amounts shall be included other than those expressly set forth above, it being agreed that the amounts specified in A., B., C. and E. of the Form of Contract clause entitled "Contractor's Compensation" cover the cost of all other expenses whatsoever even though greater than anticipated by either party, including, but not limited to, the Contractor's or any subcontractor's home office expenses, plant, overhead, interest, profit; any insurance procured to supplement or in excess of insurance procured by the Authority; and all other items of cost and expense whether similar to or different from those herein named. Moreover, in determining the Net Cost of the Work there shall not be included any amount attributable to furnishing, delivering and maintaining non--powered hand tools, nor any amount not representing actual costs to the Contractor, and in particular, any discount, refund or credit received or receivable shall be applied to reduce the Net Cost of the Work, nor shall any amount be paid more than once even though fitting under more than one item provided for herein.

C. General

1.) No expenditure shall be included more than once in the Net Cost even though fitting under more than one item provided for above.

2.) The Contractor shall exercise his best efforts to avoid unnecessary expenditures and to keep expenditures to the minimum consistent with satisfactory performance of the Contract. Expenditures shall be included in the Net Cost only to the extent that they represent reasonable amounts for items described herein, as determined by the Engineer.

3.) No expenditure shall be included in the Net Cost on account of any subcontract agreement or other type of agreement unless the Contractor has complied with the provisions relating to such agreement set forth in the clause herein entitled "Approvals of Subcontracts, Purchases, Rentals and Sales". No payment of any type in connection with any such agreement shall be included in the Net Cost in addition to the original price here under unless such additional payment has been approved by the Engineer.

4.) When requested by the Engineer, before commencing the performance of any Work the Contractor shall furnish to the Engineer a memorandum showing the rates to be used in computing amounts to be included under subparagraph A.1.) above, and if any such rates shall change at any time or if Work is performed involving different rates for such amounts, the Contractor shall immediately furnish to the Engineer a memorandum showing such changes or different rates.

5.) The Contractor shall, at the end of each day on which Work is performed, furnish to the Engineer daily time slips showing the name or number of each employee whose salary or wages is to be included under subparagraph A.1.) above, the number of hours which he is employed on the Work and the character of his duties. Moreover, if the compensation to be paid by the Authority for any Work performed by a subcontractor is in whole or in part of the basis of cost of labor, equipment or other items of expense, the Contractor shall also, at the end of each day on which any such work is performed, furnish to the Engineer daily time slips and memoranda of the above types showing in similar detail the items of expense incurred for such Work. All the foregoing time slips and memoranda are for the purpose of enabling the Engineer to keep an accurate record of all items of expense incurred, to verify the amount of such expenses at the time they are incurred, and to determine the amount of the Net Cost, as above provided, and the furnishing thereof as above required shall be a condition precedent to payment. Accordingly the failure of the Contractor to furnish such time slips and memoranda as above required with regard to any items of expense allegedly incurred shall be deemed to be a conclusive and binding determination on his part that no such expenses were in fact incurred and shall be deemed to be a waiver by the Contractor of all rights to compensation for such expenses.

6.) The Contractor shall furnish copies of payrolls within one week after employees have been paid upon the basis of such payrolls.

7.) The Engineer, acting personally shall have authority to agree in writing with the Contractor on behalf of the Authority on methods of computing, liquidating or determining any portion of the Net Cost in lieu of the methods above provided in this numbered clause. Notwithstanding the above, however, no guarantee is made that the Engineer, acting personally, will enter into any such agreement. In determining the Contractor's compensation, the amount specified in C. of the clause entitled "Contractor's Compensation" shall be added to any such agreed upon amounts for the Net Cost of the Work.

31. APPROVALS OF SUBCONTRACTS, PURCHASES, RENTAL AND SALES

As a condition precedent to the payment by the Authority to the Contractor of any amounts to be included pursuant to the clause herein entitled "Net Cost", the Contractor shall:

A. As stipulated in the Form of Contract clause entitled "Assignments and Subcontracts", obtain the prior written approval of the Authority for each subcontract the Contractor desires to enter into, including the subcontractor and terms of the subcontract.

4.) When requested by the Engineer, before commencing the performance of any Work the Contractor shall furnish to the Engineer a memorandum showing the rates to be used in computing amounts to be included under subparagraph A.1.) above, and if any such rates shall change at any time or if Work is performed involving different rates for such amounts, the Contractor shall immediately furnish to the Engineer a memorandum showing such changes or different rates.

5.) The Contractor shall, at the end of each day on which Work is performed, furnish to the Engineer daily time slips showing the name or number of each employee whose salary or wages is to be included under subparagraph A.1.) above, the number of hours which he is employed on the Work and the character of his duties. Moreover, if the compensation to be paid by the Authority for any Work performed by a subcontractor is in whole or in part of the basis of cost of labor, equipment or other items of expense, the Contractor shall also, at the end of each day on which any such work is performed, furnish to the Engineer daily time slips and memoranda of the above types showing in similar detail the items of expense incurred for such Work. All the foregoing time slips and memoranda are for the purpose of enabling the Engineer to keep an accurate record of all items of expense incurred, to verify the amount of such expenses at the time they are incurred, and to determine the amount of the Net Cost, as above provided, and the furnishing thereof as above required shall be a condition precedent to payment. Accordingly the failure of the Contractor to furnish such time slips and memoranda as above required with regard to any items of expense allegedly incurred shall be deemed to be a conclusive and binding determination on his part that no such expenses were in fact incurred and shall be deemed to be a waiver by the Contractor of all rights to compensation for such expenses.

6.) The Contractor shall furnish copies of payrolls within one week after employees have been paid upon the basis of such payrolls.

7.) The Engineer, acting personally shall have authority to agree in writing with the Contractor on behalf of the Authority on methods of computing, liquidating or determining any portion of the Net Cost in lieu of the methods above provided in this numbered clause. Notwithstanding the above, however, no guarantee is made that the Engineer, acting personally, will enter into any such agreement. In determining the Contractor's compensation, the amount specified in C. of the clause entitled "Contractor's Compensation" shall be added to any such agreed upon amounts for the Net Cost of the Work.

31. APPROVALS OF SUBCONTRACTS, PURCHASES, RENTAL AND SALES

As a condition precedent to the payment by the Authority to the Contractor of any amounts to be included pursuant to the clause herein entitled "Net Cost", the Contractor shall:

A. As stipulated in the Form of Contract clause entitled "Assignments and Subcontracts", obtain the prior written approval of the Authority for each subcontract the Contractor desires to enter into, including the subcontractor and terms of the subcontract.

B. Obtain the prior written approval of the Engineer, unless otherwise ordered by the Engineer, in which case the Contractor shall immediately obtain subsequent written approval, for any purchase or rental of materials, tools and equipment totaling more than One Thousand Dollars ($1,000.00). Unless otherwise authorized in writing by the Engineer, the Contractor shall solicit at least two (2) telephone bids with respect to any such purchase or rental totaling more than One Thousand Dollars (1,000.00) but less than Five Thousand Dollars ($5,000.00) and shall solicit at least three (3) written bids with respect to any such purchase or rental totaling more than Five Thousand Dollars ($5,000.00).

C. With respect to any purchase or rental of materials, tools, equipment or construction aids containing any one item costing more than One Thousand Dollars ($1,000.00), submit its proposed purchase order or rental agreement to the Engineer for approval. Such purchase order or rental agreement shall be accompanied by a memorandum stating the bids received and by copies of the appropriate bid or bids, in writing.

D. Obtain prior written approval from the Engineer for any sales of used materials tools or equipment. Unless otherwise authorized in writing by the Engineer, the Contractor shall solicit at least two (2) telephone bids with respect to any such sales with an estimated value of more than One Thousand Dollars ($1,000.00) but less than Five Thousand Dollars ($5,000.00) and shall solicit at least three (3) written bids with respect to any such sales with an estimated value of more than Five Thousand Dollars ($5,000.00).

E. With respect to any sales of used materials, tools, equipment or construction aids containing any one item with an estimated value of more than One Thousand Dollars ($1,000.00), submit proposed bill of sale to the Engineer for approval. Such bill of sale shall be accompanied by a memorandum stating the bids received and by copies of the appropriate bid or bids, if in writing.

F. Check in all materials, tools, construction aids and equipment and have responsible representatives who have been previously designated and identified in writing to the Engineer submit all such original, signed delivery tickets along with the vendor's invoice. With respect to sales for salvage, the responsible representatives shall check out all used materials and shall forward signed delivery tickets to the Engineer after the salvage items are properly delivered.

G. In addition to the above requirements, with respect to the rental of materials, tools, equipment or construction aids owned by the Contractor, submit in writing for approval by the Engineer a list of the equipment proposed to be used, including the estimated length of use.

H. Notwithstanding anything to the contrary contained in this numbered clause, the Authority shall not be liable for any amount attributable to the purchase of non powered hand tools.

32. COMPUTATION OF RENTAL FOR CONSTRUCTION EQUIPMENT

The rental for equipment, whether owned by the Contractor or subcontractors or rented from others and notwithstanding the actual price of any rental or actual costs associated with such equipment, shall be computed by the Engineer on the basis of the following:

A.

1.) Hourly rental for those items of equipment listed in the "Rental Rate Blue Book" (published by Machinery Information Division, K III Directory Corporation, 1735 Technology Drive, Suite 410, San Jose, California 95110), hereinafter called "the Blue Book"), shall be 100% of the applicable rates as listed in said book, reduced to an hourly basis (see formula below), except that such applicable rates shall be reduced by 50% for all hours of rental payable hereunder in excess of 8 hours each day. The edition of this publication to be used shall be the one in effect on the date of the actual rental of the equipment. The "Estimated Operating Cost per Hour" as set forth for such item of equipment in the Blue Book shall be added to the hourly rental for each hour that such equipment is actually engaged in performing Work. No amount for operating cost will be allowed during periods when such equipment is not actually engaged in performing Work (i.e., standby rental time). None of the provisions of the Blue Book shall be deemed referred to or included in this Contract except as specifically set forth in this Section.

2.) If no listing of rental rate and/or hourly operating cost for the item of tools, equipment or construction aid is in the Blue Book, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the particular item of tool, equipment or construction aid by such other means as he finds appropriate.

3.) In the event the Contractor is directed by the Engineer to immediately perform Work within 24 hours of the direction to proceed, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the items of equipment necessary to perform such Work by such means as he finds appropriate. However, if the equipment is owned by the Contractor or owned by a subsidiary of the Contractor, the Blue Book rates will apply as set forth in this clause.

B. When utilizing the rental rates appearing in the Blue Book, the Engineer shall determine the applicable rate and the hourly rental determined therefrom by applying the following criteria:

1.) The rate to be applied for an item of tool, equipment or construction aid used shall be the monthly rates from the foregoing publication.

The pro rata portion which one hour bears to the applicable rate shall be determined in accordance with the following formula:

Hourly rate based on monthly rental	1/176 of monthly rental from Blue Book

2.) The rental rate shall be multiplied by the applicable regional adjustment factor shown for such item of tool, equipment or construction aid in the Blue Book. The adjustment factor shall not apply to the hourly operating cost.

3.) If the Engineer should determine that the nature, number of pieces or size of the tool, equipment or construction aid used by the Contractor in connection with the Work is more pieces, or larger or more elaborate, as the case may be, than the size or nature of the minimum equipment determined by the Engineer to be suitable for the Work, the reasonable rental will not be based upon the tool, equipment or construction aid used by the Contractor but will be based on the smallest quantity or smallest or least elaborate tool, equipment or construction aid determined by the Engineer to have been suitable for the performance of the Work.

1.) Hourly rental for those items of equipment listed in the "Rental Rate Blue Book" (published by Machinery Information Division, K III Directory Corporation, 1735 Technology Drive, Suite 410, San Jose, California 95110), hereinafter called "the Blue Book"), shall be 100% of the applicable rates as listed in said book, reduced to an hourly basis (see formula below), except that such applicable rates shall be reduced by 50% for all hours of rental payable hereunder in excess of 8 hours each day. The edition of this publication to be used shall be the one in effect on the date of the actual rental of the equipment. The "Estimated Operating Cost per Hour" as set forth for such item of equipment in the Blue Book shall be added to the hourly rental for each hour that such equipment is actually engaged in performing Work. No amount for operating cost will be allowed during periods when such equipment is not actually engaged in performing Work (i.e., standby rental time). None of the provisions of the Blue Book shall be deemed referred to or included in this Contract except as specifically set forth in this Section.

2.) If no listing of rental rate and/or hourly operating cost for the item of tools, equipment or construction aid is in the Blue Book, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the particular item of tool, equipment or construction aid by such other means as he finds appropriate.

3.) In the event the Contractor is directed by the Engineer to immediately perform Work within 24 hours of the direction to proceed, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the items of equipment necessary to perform such Work by such means as he finds appropriate. However, if the equipment is owned by the Contractor or owned by a subsidiary of the Contractor, the Blue Book rates will apply as set forth in this clause.

B. When utilizing the rental rates appearing in the Blue Book, the Engineer shall determine the applicable rate and the hourly rental determined therefrom by applying the following criteria:

1.) The rate to be applied for an item of tool, equipment or construction aid used shall be the monthly rates from the foregoing publication.

The pro rata portion which one hour bears to the applicable rate shall be determined in accordance with the following formula:

Hourly rate based on monthly rental	1/176 of monthly rental from Blue Book

2.) The rental rate shall be multiplied by the applicable regional adjustment factor shown for such item of tool, equipment or construction aid in the Blue Book. The adjustment factor shall not apply to the hourly operating cost.

3.) If the Engineer should determine that the nature, number of pieces or size of the tool, equipment or construction aid used by the Contractor in connection with the Work is more pieces, or larger or more elaborate, as the case may be, than the size or nature of the minimum equipment determined by the Engin
the reasonable rental will not be based upon the tool,
used by the Contractor but will be based on the smallest quantity or smallest or least elaborate tool, equipment or construction aid determined by the Engineer to have been suitable for the performance of the Work.

C. There will be added to the rental as computed above (a) the reasonable cost of transporting such tool, equipment or construction aid to and from the construction site, including applicable tolls, and (b) notwithstanding the number of hours during which such of tool, equipment or construction aid is utilized, the minimum rental therefor will be for a period of eight hours.

D. Notwithstanding anything to the contrary contained in this numbered clause, the Authority shall not be liable for any amount attributable to the rental of non powered hand tools.

33. ADJUSTMENTS OF LUMP SUM

If any Unclassified Work required by the Contract Drawings and Specifications in their present form shall be countermanded or reduced, the Engineer shall have full authority on behalf of both parties to make such adjustment by way of reduction in the Lump Sum as he may in his sole discretion deem equitable and reasonable, and in making such adjustment, no allowance to the Contractor shall be made for anticipated profits.

The Chief Engineer shall have authority to agree in writing with the Contractor for adjustments by way of reduction in the Lump Sum in lieu of those for which provision is heretofore made in this numbered clause.

34. COMPENSATION FOR EXTRA WORK

The Chief Engineer shall have authority to agree in writing with the Contractor on behalf of the Authority upon lump sum or other compensation for Extra Work in lieu of the compensation for which provision is hereinafter made in this numbered clause.

If such agreement on compensation is not made, and Extra Work be performed, the Contractor's compensation shall be increased by the following amounts and such amounts only:

1.) For Extra Work consisting of refuse container services, and amount equal to the actual net cost in money of the labor and materials and rental for equipment (other than small tools) required for the provision of such services, plus an amount equal to the percentage inserted by the Contractor in C. of the clause entitled "Contractor's Compensation" times the amount equal to the actual net cost in money of the labor and material and rental for equipment (other than small tools) required for such Extra Work.

2.) For Extra Work consisting of performance of construction work at the construction site, performed by the Contractor personally or by a subcontractor, an amount equal to the actual net cost in money of the labor and materials and rental for equipment (other than small tools) required for such Extra Work, plus an amount equal to the percentage inserted by the Contractor in C. of the clause entitled "Contractor's Compensation" times the amount equal to the actual net cost in money of the labor and material and rental for equipment (other than small tools) required for such Extra Work.

As used in this numbered clause (and in this clause only):

"Refuse Container Services" means the delivery, removal and emptying of refuse containers as required during the performance of Extra Work subject to approval by the Engineer.

"Labor" means foremen, surveyors, laborers, mechanics and other employees below the rank of superintendent, exclusive of timekeepers, directly employed at the construction site, whether employed by the Contractor or by the subcontractors, subject to the Engineer's authority to determine what employees of any category are "required for Extra Work" and as to the portion of their time allotted to Extra Work; and "cost of labor" means the wages actually paid to and received by such employees; however, all wages actually paid that are in excess of the prevailing wages in the performance of Extra Work shall be subject, on each occasion, to the initial and continuing approval of the Engineer in advance of the performance of such Extra Work; plus a proper proportion of (a) premiums, if any, actually paid by the employer for Workers' Compensation Insurance upon the basis of such wages, (b) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligation upon the basis of such wages, and (c) taxes actually paid by the employer pursuant to law upon the basis of such wages. "Employees" as used above means only the employees of one employer.

"Materials" means temporary and consumable materials as well as permanent materials; and "cost of materials" means the price (including taxes actually paid by the Contractor pursuant to law upon the basis of such materials) for which such materials are sold for cash by the manufacturers or producers thereof, or by regular dealers therein, whether or not such materials are purchased directly from the manufacturer, producer or dealer (or if the Contractor is the manufacturer or producer thereof, the reasonable cost to the Contractor of the manufacture and production), plus the reasonable cost of delivering such materials to the construction site in the event that the price paid to the manufacturer, producer or dealer does not include delivery and in case of temporary materials, less their salvage value, if any.

"Work day" in reference to an item of equipment means a day other than a Saturday, Sunday or legal holiday except that if the particular item of equipment is actually utilized at the construction site by the Contractor or subcontractors under this or any other Contract with the Authority on a Saturday, Sunday or legal holiday said day shall be deemed a work day.

The rental for equipment, whether owned by the Contractor or subcontractors or rented from others and notwithstanding the actual price of any rental or actual costs associated with such equipment, shall be computed by the Engineer in accordance with the clause entitled "Computation of Rental for construction Equipment".

Whenever any Extra Work is performed (whether by the Contractor directly or through a subcontractor), the Contractor shall, at the end of each day, submit to the Engineer (a) daily time slips showing the name and number of each workman employed on such Work, the number of hours which he is employed thereon, the character of his duties, and the wages to be paid to him, (b) a memorandum showing the rates and amounts of Workers' Compensation Insurance premiums, if any, and state and federal taxes based on such wages, and vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligation upon the basis of such wages (c) a memorandum showing the amount and character of the materials furnished for such Work, from whom they were purchased and the amount to be paid therefor, and (d) a memorandum of equipment used in the performance of such Work, listing the actual hours of operation for each piece of equipment, together with the rental claimed therefor. Such memoranda and time slips are for the purpose of enabling the Engineer to determine the amounts to be paid by the Authority under this numbered clause; and accordingly, they shall constitute a condition precedent to such payment and the failure of the Contractor to furnish them with respect to any Work shall constitute a conclusive and binding determination on his part that such Work is not Extra Work and shall constitute a waiver by the Contractor of claims for payment for such Work. The Contractors compensation for Extra Work shall be subject to audit review by the Authority. The Engineer will notify the Contractor that an audit review will be conducted no later than 90 days from the dates of such notification. The Engineer will also provide the Contractor with an estimated duration of the audit. During the audit review, the Contractor shall provide records to substantiate the memorandum and time slips submitted to the Engineer. Failure to provide such Contractor or subcontractor records may result in a reduction or total denial of material, equipment and labor costs for Extra Work. Upon completion of the audit review, the Contractor will be provided with the audit findings of the Authority. If the Contractor disagrees in whole or in part with the audit findings, the Contractor shall notify the Authority of such disagreement in writing within 30 days of receipt of said audit findings or the Authority will deem the audit findings to be final and acceptable to the Contractor. In the event that the Chief Engineer and the Contractor shall agree in writing upon a lump sum or other compensation for Extra Work in lieu of compensation as provided in the second paragraph of this clause, the daily time slips and memoranda required by this paragraph shall not be required subsequent to the date on which such agreement has been reached.

35. COMPENSATION FOR PREMIUM TIME

Where the Engineer directs that the Contractor perform Work at times other than those elsewhere specified in the Contract, and the Contractor directly or through a subcontractor is obligated by the provisions of its applicable collective bargaining agreement to pay premium time rates for such Work then, the Contractor shall be compensated for the cost differential between regular time rates and premium time rates at an amount equal to the total of the following:

A. For premium time rates paid by the Contractor to its own forces, an amount equal to the premium time portion of the salaries and wages which the employer is required to pay and actually pays to its employees pursuant to the terms of its applicable collective bargaining agreement for the overtime period or periods described above, plus a proper proportion, if any, computed upon the basis of premium time salaries and wages of (1) taxes actually paid by the employer pursuant to law, (2) vacation allowances, other fringe benefits and union dues and assessments which the employer actually pays pursuant to contractual obligations, and (3) increased premiums paid by the Contractor personally, specifically allocable to the insurance required by this Contract, plus five per cent (5%) of such premium portion.

B. For premium time rates paid by a subcontractor, an amount equal to the premium time portion of the salaries and wages which the employer is required to pay and actually pays to its employees pursuant to the terms of its applicable collective bargaining agreement for the overtime period or periods described above, plus a proper proportion, if any, computed upon the basis of premium time salaries and wages of (1) taxes actually paid by the employer pursuant to law, (2) vacation allowances, other fringe benefits and union dues and assessments which the employer actually pays pursuant to contractual obligations, and (3) increased premiums paid by a subcontractor, specifically allocable to the insurance required by this Contract, plus five per cent (5%) of such premium portion, plus two per cent (2%) of the foregoing cost.

All additions to the Contractor's compensation provided for in this clause require the prior written approval of the Engineer and are conditioned on the Contractor's verifiable by the Authority payment of such amounts to his subcontractor.

The additions to the Contractor's compensation provided in this clause shall not apply where the Engineer directs the Contractor to perform work at times other than those specified elsewhere in the Contract and also determines that such work is required to mitigate previous delays in the Contractor's performance of Work.

36. COMPENSATION FOR EMERGENCY DELAYS

If the Contractor is specifically directed by the Engineer to suspend his operations as stipulated in the Section of Division 1 of the Specifications entitled "Conditions and Precautions" or if the Contractor is specifically directed not to start his operations at a time when operations are permitted to start as stipulated in such Section, and if solely because of such suspension or direction not to start any of the Contractor's or subcontractor's employees or equipment then engaged in or about to start such Work are necessarily kept idle at the construction site, during the hours when they would otherwise be engaged in the performance of the Work, then the Contractor's compensation shall be increased by an amount equal to the salaries and wages in amounts approved by the Engineer which the employer is required to pay and actually pays to such employees for the period or periods of such idleness, plus a proper proportion of (a) the premiums actually paid by the employer for Workers' Compensation Insurance, if any, upon the basis of such salaries and wages, (b) taxes actually paid by the employer pursuant to law upon the basis of such salaries and wages, and (c) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligations upon the basis of such salaries and wages, and in addition thereto such rental as the Engineer deems reasonable for such equipment during the period or periods of such idleness. The rental for idle equipment shall be computed by the Engineer in accordance with the provisions of the clause of the Form of Contract entitled "Idle Salaried Men and Equipment".

In the event that the Contractor deems that any payment should be made pursuant to this numbered clause, he shall give prompt written notice to the Engineer stating the reasons why he believes such payments should be made and shall moreover, furnish to the Engineer at the end of each day, a memorandum showing the name, payroll title, salary rate and employer of each of the workingmen, and description, owner and claimed rental rate for each item of equipment claimed to have been kept idle. Said notice and memorandum are for the purpose of enabling the Engineer to verify the Contractor's claim at the time. Accordingly, notwithstanding any other provisions hereof, the failure of the Contractor to furnish such notice and memorandum shall constitute a conclusive binding determination on his part that he is not entitled to compensation as provided herein and shall constitute a waiver by the Contractor of all claims for such payment, such notice and memorandum being conditions precedent to payment under this numbered clause.

37. MONTHLY ADVANCES

On or about the first day of each month, the Engineer shall (upon receipt from the Contractor of such information as he may require, including a certification in writing, in such form as may be required pursuant to the clause hereunder entitled "Prevailing Rate of Wage", that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause) estimate and certify to the Authority the approximate amount of Work performed and compensation earned by the Contractor up to that time showing separately:

A. The approximate amount of Classified Work performed by the Contractor up to that time and a sum determined from such Work in accordance with the units of measurement and unit prices specified in the Schedule of Unit Prices.

B. The approximate amount of Unclassified Work performed by the Contractor up to that time and a sum bearing the same proportion to the Lump Sum as the Unclassified Work performed (other than Extra Work) bears to the total amount of such Work performed and to be performed (other than Extra Work), and

C. An amount equal to the percentage specified in C. of the clause entitled "Contractor's Compensation" times such Net Cost amount in D. below.

D. The approximate amount of the Net Cost of the Work performed up to that time for which provision is made elsewhere in the Contract for the Contractor to be compensated for Work at the Net Cost of such Work.

E. The approximate amount of Work performed up to that time for which compensation is provided in E. of the clause entitled "Contractor's Compensation".

As an aid to the Contractor and to facilitate his performance, the Authority shall, within fifteen days after the receipt of each suchmonthly certificate, advance to the Contractor by check the sums so certified, minus, however, five per cent (5%) of the sum certified pursuant to subparagraphs A and B of this numbered clause, and minus all prior advances and payments to the Contractor or for his account.

Within seven days of receipt of any sum attributable to Work performed by a subcontractor or materialman or within such later period as is provided in the subcontract or purchase agreement, the Contractor shall advance to the subcontractor or materialman said sum, less such amount, if any, as the Contractor is authorized to retain under the subcontract or purchase agreement.

Notwithstanding the above, the Authority shall have the right, at its sole discretion, to directly pay the subcontractors and material suppliers who perform Work for or furnish materials to the Contractor in connection with the Work of this Contract.

Prior to certifying any amount for payment hereunder, the Engineer may require that the Contractor submit a certification accurately and fully setting forth the total amount due and payable to each subcontractor and supplier for Work performed or materials provided by such subcontractor or supplier in connection with the Work of this Contract. Any payment made by the Authority to a subcontractor or supplier pursuant to the provisions of this numbered clause shall be made in reliance upon such certification and all such payments shall be considered as advances to the Contractor of the compensation payable hereunder. No such payment shall relieve the Contractor of any of its obligations hereunder.

Furthermore, within fifteen (15) days of the Contractor's receipt of the Authority acceptance of the Contractor's Proposal, the Contractor shall submit to the Engineer a listing of all subcontract and material supply agreements entered into by the Contractor for the performance of Work required by this Contract. Such listing shall include the names and addresses of each such subcontractor and supplier and the amounts payable under each such agreement. As and when any modifications are made to such agreements or any additional subcontracts or supply agreements are entered into, the Contractor shall inform the Engineer of such and shall indicate the amounts payable thereunder.

Nothing contained herein shall be deemed to create any additional rights in such subcontractors or suppliers or to alter the rights of the Authority as such are set forth in the clause hereof entitled "Withholding of Payments".

38. ADDITIONAL COMPENSATION FOR EARLY AND ON-TIME COMPLETION

Subject to the sole determination of the Engineer that all designated Stages of Work have been completed in full compliance with all requirements set forth herein, the Contractor will be compensated for early and on-time completion of Work in accordance within the time or times below stipulated or within such time or times as extended in accordance with the clause hereof entitled "Extensions of Time" as follows:

A. An amount equal to Fifteen Million Dollars ($15,000,000) for completion of all Work to shift traffic to the new east elevated roadway and to demolish the existing arch roadway structure from panel point 5S to panel point 5N by 11:59 PM on September 15, 2015 or 753 calendar days from award, whichever is later. If this Work is not complete by this date, the amount of Fifteen Million Dollars shall be reduced by $166,000 per calendar day until completed ; but if this Work is not complete until or after December 14, 2015 or 843 calendar days from award, whichever is later, then the Contractor will be deemed not to have achieved early or on-time completion and will not be compensated therefor.

B. An amount equal to Five Million Dollars ($5,000,000) for completion of all Work to restore two lanes of traffic in each direction on the new elevated roadway inclusive of shoulders, ramps, permanent striping, roadway lighting, and signage; completion of the permanent toll collection system; completion of all buildings and associated components; completion of all electrical and electronic systems; completion of the fire standpipe system inclusive of pumps and controls; and completion of all site work including drainage systems by 11:59 PM on March 7, 2017 or 1292 calendar days from award, whichever is later. If this Work is not complete by this date, the amount of Five Million Dollars shall be reduced by $83,000 per calendar day until completed; but if this Work is not complete until or after May 6, 2017 or 1352 calendar days from award, whichever is later, then the Contractor will be deemed not to have achieved early or on-time completion and will not be compensated therefor.

The amounts under A. and B. above shall be cumulative.

39. RELEASE OF MONIES PREVIOUSLY WITHHELD FROM MONTHLY ADVANCES UPON RENDITION OF A CERTIFICATE OF SUBSTANTIAL COMPLETION

After the rendition of the Certificate of Substantial Completion and with the approval of the Engineer, an amount up to 80% of the total amount of monies withheld from the Contractor's monthly advances in accordance with the preceding clause may be released to the Contractor. If, in the Engineer's judgment, no monies, or less than 80% of the total amount of monies withheld should be released it will be based on, but not limited to, the estimated value of the remaining Work, unresolved claims by subcontractors, the estimate of possible audit adjustments and an assessment of the risks to the Authority in making such a release of monies. This clause does not create a right to such a release of monies or to any specific percentage release, all of which shall remain purely the discretionary decision of the Engineer.

Prior to the release of any amount withheld from the Contractor's monthly advances by the Authority, the Contractor shall submit to the Engineer a certification of all unresolved requests for additional compensation including all items in dispute and potential claims which the Contractor had actual knowledge of or by reasonable inspection and inquiry should have known of, to the date of the certification. Any such items not made known to the Authority by inclusion in the certification of additional compensation requests submitted by the Contractor will be deemed to have been released by the Contractor. Notwithstanding the above provisions, before making any release of monies the Engineer may require the Contractor to submit further information for the Engineer's review and analysis, and shall require the Contractor to execute a separate written release of claims as described above in a form acceptable to the Authority.

Nothing contained herein shall be deemed to alter or diminish the rights of the Authority as such are set forth in the clauses hereof entitled "Withholding of Payments", "Final Payment", "Monthly Advances" or under any other clause of this Contract relating to compensation to the Contractor, any release of monies hereunder being purely at the discretion of the Engineer.

40. FINAL PAYMENT

After the rendition of the Certificate of Final Completion and upon receipt from the Contractor of such information as may be required, the Engineer shall certify in writing to the Authority and to the Contractor the total compensation earned by the Contractor.

See the Form of Contract clause entitled "Certificate of Final Completion" which requires as a prerequisite for the issuance of such certificate the submission of a "Summary of Asbestos Removal and Disposal Costs".

If so required, the Contractor shall thereupon (i) certify to the Authority in writing, in such form as may be required pursuant to the clause hereunder entitled "Prevailing Rate of Wage", that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause and (ii) furnish to the Authority a detailed sworn statement of all claims, just and unjust, of subcontractors, materialmen and other third persons then outstanding and which he has reason to believe may thereafter be made on account of the Work.

Within thirty days after issuance of such certificate of total compensation earned (or within thirty days after receipt of the documents provided for in the immediately preceding paragraph, if required), the Authority shall pay to the Contractor by check the amount stated in said certificate, less all other payments and advances whatsoever to or for the account of the Contractor. All prior estimates and payments shall be subject to correction in this payment, which is throughout this Contract called the Final Payment.

The acceptance by the Contractor, or by anyone claiming by or through him, of Final Payment shall be and shall operate as a release to the Authority of all claims and of all liability to the Contractor for all things done or furnished in connection with the Contract and for every act and neglect of the Authority and others relating to or arising out of the Contract, including claims arising out of breach of contract and claims based on claims of third persons, excepting only his claims for reimbursement for certain sales taxes as hereinbefore provided. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations in connection with this Contract or the Performance and Payment Bond.

The Contractor's agreement as provided in the immediately preceding paragraph above shall be deemed to be based upon the consideration forming part of this Contract as a whole and not to be gratuitous; but in any event even if deemed gratuitous and without consideration, such agreement as provided in the immediately preceding paragraph above shall nevertheless be effective. Such release shall include all claims, whether or not in litigation and even though still under consideration by the Authority or the Engineer. Such release shall be effective notwithstanding any purported reservation of right by the Contractor to preserve such claim. The acceptance of any check designated as "Final Payment" or bearing any similar designation shall be conclusively presumed to demonstrate the intent of the Contractor that such payment was intended to be accepted as final, with the consequences provided in this numbered clause, notwithstanding any purported reservation of rights.

The Contractor agrees that he shall not be entitled to, and hereby waives any right he might otherwise have to, and shall not seek any judgment whether under this Contract or otherwise for any such Final Payment or for an amount equivalent thereto or based thereon, or for any part thereof, if such judgment would have the effect of varying, setting aside, disregarding or making inapplicable the terms of this numbered clause or have the effect in any way of entitling the Contractor to accept such Final Payment or an amount equivalent thereto or based thereon or any part thereof other than in the same fashion as a voluntary acceptance of a Final Payment subject to all the terms of this Contract including this numbered clause, unless and until the Contractor should obtain a judgment on any claim arising out of or in connection with this Contract (including a claim based on breach of contract) for an amount not included in said Final Payment. In any case in which interest is allowable on the amount of the Final Payment, such interest shall be at the rate of 6% per annum for the period, if any, in which such interest is due.

41. WITHHOLDING OF PAYMENTS

If (1) the Contractor fails to perform any of his obligations under this Contract or any other agreement between the Authority and the Contractor (including his obligation to the Authority to pay any claim lawfully made against him by any materialman, subcontractor or workman or other person which arises out of or in connection with the performance of this Contract or any other agreement with the Authority) or (2) any claim (just or unjust) which arises out of or in connection with this Contract or any other agreement between the Authority and the Contractor is made against the Authority or (3) any subcontractor under this Contract or any other agreement between the Authority and the Contractor fails to pay any claims lawfully made against him by any materialman, subcontractor, workman or other third person which arises out of or in connection with this Contract or any other agreement between the Authority and the Contractor or if in the opinion of the Chief Engineer any of the aforesaid contingencies is likely to arise, then the Authority shall have the right, in its discretion, to withhold out of any payment (final or otherwise and even though such payment has already been certified as due) such sums as the Chief Engineer may deem ample to protect it against delay or loss or to assure the payment of just claims of third persons, and to apply such sums in such manner as the Chief Engineer may deem proper to secure such protection or satisfy such claims. All sums so applied shall be deducted from the Contractor's compensation. Omission by the Authority to withhold out of any payment, final or otherwise, a sum for any of the above contingencies, even though such contingency has occurred at the time of such payment, shall not be deemed to indicate that the Authority does not intend to exercise its right with respect to such contingency. Neither the above provisions for rights of the Authority to withhold and apply monies nor any exercise or attempted exercise of, or omission to exercise, such rights by the Authority shall create any obligation of any kind to such materialmen, subcontractors, workmen or other third persons.

Until actual payment to the Contractor, his right to any amount to be paid under this Contract (even though such amount has already been certified as due) shall be subordinate to the rights of the Authority under this numbered clause.

In the event that wages and/or supplements have been paid in an amount less than as required by this Contract, the Authority shall also have the right to withhold from the Contractor out of any payment, final or otherwise, on this, or any other open contract that the Contractor has with the Authority, so much as may be necessary to pay to laborers, mechanics, architects, draftsmen, engineers and technical workers, and others employed on the Work, the difference between the sums such persons should have received as wages and/or supplements and the amounts they actually received, and to pay such sums over to such persons. All such payments shall be deemed to be payments for the Contractor's account. In addition, the Contractor shall be required to pay to the Authority an amount equal to the Authority's cost of any investigation conducted by or on behalf of the Authority, that discovers a failure to pay wages and/or supplements as required by this Contract by the Contractor or its subcontractors, the cost of such investigation to be determined by the Chief Engineer personally. If the Contractor fails or refuses to pay for the cost of any such investigation after demand by the Authority, the Authority may deduct from any amount payable to the Contractor by the Authority, under the Contract or under any other open contract between the Contractor and the Authority, an amount equal to the cost of such investigation.

If, however, the payment of any amount due to the Contractor shall be improperly delayed by the fault of the Authority, the Authority shall pay the Contractor interest thereon at the rate of six percent (6%) per annum for the period of delay, it being agreed that such interest shall be in lieu of and in liquidation of any damages to the Contractor because of such delay.

CHAPTER III

PROVISIONS RELATING TO TIME

42. TIME FOR COMPLETION AND DAMAGES FOR DELAY

The Contractor shall complete the performance of all Work under this Contract, as follows:

I. Complete all Work to shift traffic to the new east elevated roadway and to demolish the existing arch roadway structure from panel point 5S to panel point 5N by 11:59 PM on December 14, 2015 or 843 calendar days from award, whichever is later.

II. Complete all Work to restore two lanes of traffic in each direction on the new elevated roadway, inclusive of shoulders, ramps, permanent striping, roadway lighting and signage; complete the permanent toll collection system; complete all buildings and associated components; complete all electrical and electronic systems; complete the fire standpipe system inclusive of pumps and controls; and complete all site work including drainage systems and landscaping by 11:59 PM on May 6, 2017 or 1352 calendar days from award, whichever is later.

III. Complete all Work by August 22, 2017 or 1,460 calendar days from award, whichever is later.

The Contractor shall not commence the performance of the Work until the later of the following dates:

A. If a Performance and Payment Bond is required, the date of receipt by him of notice from the Authority that the Performance and Payment Bond furnished by him is satisfactory;

B. If Chapter V of the "Form of Contract" contains a clause entitled "Insurance Procured by Contractor", the date of receipt by him of notice from the Authority that the insurance procured by him pursuant to said clause is satisfactory, as evidenced by the certificate to be furnished in accordance with said clause.

The time for completion shall not be extended on account of the time required to furnish the documents referred to in subparagraphs A and B above, but the Authority shall give notice to the Contractor within ten days after receipt of the Performance and Payment Bond or certificate of insurance as to whether or not such bond or insurance is satisfactory. The Contractor's obligations for the performance and completion of the Work within the time or times provided for in this Contract are of the essence of this Contract. The Contractor guarantees that he can and will complete the performance of the Work within the time hereinbefore stipulated or within the time as extended in accordance with the clause hereof entitled "Extensions of Time." Inasmuch as the damage and loss to the Authority which will result from delay in completing the performance of the Work within the time herein stipulated will include items of loss whose amount will be incapable or very difficult of accurate estimation, the damages to the Authority for each calendar day or other time interval by which the Contractor does not complete performance of the Work within the time or times above stipulated or within such time or times as extended in accordance with the clause hereof entitled "Extensions of Time," shall be liquidated in the sum of the following amounts:

A. Forty Thousand Dollars ($40,000) after 12:01 AM for the first day and 12:01 AM for each subsequent calendar day by which the Contractor fails to complete the Work in accordance with subparagraph I above.

B. Ten Thousand Dollars ($10,000) for each calendar day by which the Contractor fails to complete the Work in accordance with subparagraph II above.

C. Ten Thousand Dollars ($10,000) for each calendar day by which the Contractor fails to complete the Work in accordance with subparagraph III above.

The liquidated damages under subparagraphs A B and C, above shall be cumulative.

43. EXTENSIONS OF TIME

The time above provided for completion of any part of the Contract shall be extended (subject, however, to the provisions of this numbered clause) only if in the opinion of the Engineer the Contractor is necessarily delayed in completing such part by such time solely and directly by a cause which meets all the following conditions:

A. Such cause is beyond the Contractor's control and arises without his fault;

B. Such cause comes into existence after the opening of Proposals on this Contract and neither was nor could have been anticipated by investigation before such opening.

Variations in temperature and precipitation shall be conclusively deemed to have been anticipated before opening of such Proposals on this Contract except to the extent that the actual monthly average temperature varies from a temperature which is 10 per cent (10%) above or below the monthly normal temperature and except to the extent that the actual number of days of precipitation (of 0.1 inch or more) per month exceeds a number equal to two plus the normal number of days of precipitation per month.

In any case, the variations in temperature and precipitation described in the immediately preceding sentence will be cause for an extension of time only if occurring between the actual time of commencement of the Work at the construction site and the time for completion stipulated in the clause hereof entitled "Time for Completion and Damages for Delay" (or such time as extended as provided for herein). In the case of portions of months the number of days will be pro-rated by the Engineer. Temperature and precipitation shall be as recorded by the U. S. Weather Bureau in its publications, including that entitled "Local Climatological Data with Comparative Data", which is applicable to the area in which the Work is to be performed, and in the case of precipitation, the normal number of days of precipitation (of 0.1 inch or more) per month as abstracted from the aforementioned publications are as follows:

Month	**Normal number of days per month on which precipitation exceeds 0.1 inch**
January	7
February	7
March	8
April	7
May	6
June	6
July	5
August	7
September	6
October	6
November	7
December	7

In any event, even though a cause of delay meets all the above conditions, an extension shall be granted only to the extent that (i) the performance of the Work is actually and necessarily delayed and (ii) the effect of such cause cannot be anticipated and avoided or mitigated by the exercise of all reasonable precautions, efforts and measures (including planning, scheduling and rescheduling), whether before or after the occurrence of the cause of delay, and an extension shall not be granted for a cause of delay which would not have affected the performance of the Contract were it not for the fault of the Contractor or for other delay for which the Contractor is not entitled to an extension of time.

Any reference herein to the Contractor shall be deemed to include subcontractors and materialmen, whether or not in privity of contract with the Contractor, and employees and others performing any part of the Contract and all the foregoing shall be considered as agents of the Contractor.

The period of any extension of time shall be that necessary to make up the time actually lost, subject to the provisions of this numbered clause, and shall be only for the portion of the Contract actually delayed. The Engineer may defer all or part of his decision on an extension and any extension may be rescinded or shortened if it subsequently is found that the delays can be overcome or reduced by the exercise of reasonable precautions, efforts and measures.

As a condition precedent to an extension of time, the Contractor shall give written notice to the Engineer within 48 hours after the time when he knows or should know of any cause which might under any circumstances result in delay for which he claims or may claim an extension of time (including those causes which the Authority is responsible for or has knowledge of), specifically stating that an extension is or may be claimed, identifying such cause and describing, as fully as practicable at the time, the nature and expected duration of the delay and its effect on the various portions of the Contract. Since the possible necessity for an extension of time may materially alter the scheduling, plans and other actions of the Authority, and since, with sufficient opportunity, the Authority might if it so elects attempt to mitigate the effect of a delay for which an extension of time might be claimed, and since merely oral notice may cause disputes as to the existence or substance thereof, the giving of written notice as above required shall be of the essence of the Contractor's obligations and failure of the Contractor to give written notice as above required shall be a conclusive waiver of an extension of time.

It shall in all cases be presumed that no extension, or further extension, of time is due unless the Contractor shall affirmatively demonstrate to the satisfaction of the Engineer that it is. To this end the Contractor shall maintain adequate records supporting any claim for an extension of time, and in the absence of such records, the foregoing presumption shall be deemed conclusive.

44. IDLE SALARIED MEN AND EQUIPMENT

If any salaried men or equipment of the Contractor or any subcontractor are necessarily kept continuously idle and wholly unoccupied at the construction site for a full day on each of two or more full days on which they would be engaged in the performance of the Work but for causes due solely to acts or omissions of the Authority or the Engineer occurring after the opening of Proposals on this Contract, and if such idleness is not due to any cause within the control of the Contractor or of any of his subcontractors or materialmen or his or their employees, then the Authority shall pay to the Contractor and the Contractor shall accept (in addition to any sums otherwise payable under this Contract, and in full satisfaction of and in liquidation of all claims for damages because of such act or omission of the Authority or the Engineer) an amount equal to that which the employer actually pays such salaried employees during such full days of idleness, plus a proper proportion of the premiums actually paid for Workers Compensation Insurance upon the basis of such salaries, if any, a proper proportion of vacation allowances and union dues and assessments actually paid by the employer pursuant to contractual obligations on the basis of such salaries, and a proper proportion of the taxes actually paid by the employer pursuant to law upon the basis of such salaries and plus such rental for such idle equipment as the Engineer deems reasonable. The rental for idle equipment shall be computed by the Engineer in accordance with the provisions of the clause of the Form of Contract entitled "Computation of Rental for Construction Equipment"; provided, however, that the seven per cent (7%) of the rental to be paid in accordance with said clause in the case of equipment utilized by subcontractors shall not be payable in connection with such idle equipment; and provided further that the provisions of subparagraph C of said clause shall not be applicable to such idle equipment.

The Contractor shall give written notice to the Engineer before the end of the second of the above mentioned 2 or more full days (whether or not the Authority is aware of the existence of any circumstances which might constitute a basis for payment under this numbered clause), specifically stating that salaried men or equipment have been kept idle under circumstances which might result in payment under this numbered clause; and he shall furnish with such notice, for all the days that have occurred, and shall in addition furnish at the end of each additional day of the above mentioned 2 or more full days, (a) a memorandum showing the name, payroll title, salary rate and employer of each of the salaried men claimed to have been kept idle at the construction site, and the rates and amounts of Workers' Compensation Insurance premiums, if any, and taxes based upon their salaries and the holiday and vacation allowances and union dues and assessments which the employer must actually pay pursuant to contractual obligations based on their salaries, and (b) a memorandum of the equipment claimed to be kept idle, together with the amount claimed as rental therefor. Said notice and memoranda are for the purpose of enabling the Engineer to verify the Contractor's claim at the time, and of enabling him to take such steps as may be necessary to remedy the conditions upon which the claim is based. The furnishing of such notice and memoranda shall be a condition precedent to payment under this numbered clause, so that the day on which notice is given shall be counted as not later than the second of the above mentioned 2 or more full days and no subsequent day shall be counted for which the above memoranda are not furnished at the end of such day.

45. DELAYS TO CONTRACTOR

As between the Contractor and the Authority, the Contractor assumes the risk of all suspensions of or delays in performance of the Contract, regardless of the length thereof, arising from all causes whatsoever, whether or not relating to this Contract, including wrongful acts or omissions of the Authority, its officers, agents, employees and contractors, except only to the extent, if any, that compensation or an extension of time may be due as expressly provided for elsewhere in this Contract for such suspension or delays and except to the extent, if any, that compensation may be agreed to by the Chief Engineer in writing pursuant to the clause hereof entitled "Compensation for Extra Work" for impact costs incurred by the Contractor in connection with the performance of Extra Work. Subject only to such exceptions, the Contractor shall bear the burden of all costs, expenses and liabilities which he may incur in connection with such suspensions or delays, and all such suspensions, delays, costs, expenses and liabilities of any nature whatsoever, whether or not provided for in this Contract, shall conclusively be deemed to have been within the contemplation of the parties.

Notwithstanding any provisions of this Contract, whether relating to time of performance or otherwise, the Authority makes no representation or guaranty as to when the construction site or any part thereof will be available for the performance of the Contract or as to whether conditions at the construction site will be such as to permit the Contract to be performed thereon without interruption or by any particular sequence or method or as to whether the performance of the Contract can be completed by the time required under this Contract or by any other time.

Wherever in connection with this Contract it is required, expressly or otherwise, that the Authority shall perform any act relating to the Contract, including making available or furnishing any real property, materials, or other things, no guaranty is made by the Authority as to the time of such performance and the delay of the Authority in fulfilling such requirement shall not result in liability of any kind on the part of the Authority except only to the extent, if any, that an extension of time or compensation may be due as expressly provided for elsewhere in this Contract.

46. CANCELLATION FOR DELAY

If the performance of the Contract or any portion of it shall, in the opinion of the Chief Engineer, be materially delayed, whether or not through the fault of the Contractor, by any cause which affects the Contractor's ability to perform the Contract without affecting to the same degree the Authority's own ability to perform it, either directly or through others, the Authority shall have the right at any time during the existence of such delay to cancel this Contract as to any portion not yet performed, without prejudice to the rights, liabilities and obligations of the parties under this Contract arising out of portions already performed, provided, however, that such right of cancellation shall not exist if the delay be due to any wrongful act or omission of the Authority. In the event of such cancellation, no allowance shall be made for anticipated profits.

CHAPTER IV

CONDUCT OF CONTRACT

47. AUTHORITY OF CHIEF ENGINEER

Inasmuch as the public interest requires that the project to which this Contract relates shall be performed in the manner which the Authority, acting through the Chief Engineer, deems best, the Chief Engineer shall have absolute authority to determine what is or is not necessary or proper for or incidental to the portion thereof specified in the clause hereof entitled "General Agreement" and the Contract Drawings and Specifications shall be deemed merely his present determination on this point. In the exercise of this authority, he shall have power to alter the Contract Drawings and Specifications; to require the performance of Work not required by them in their present form, even though of a totally different character from that now required; and to vary, increase and diminish the character, quantity and quality of, or to countermand, any Work now or hereafter required. Such variation, increase, diminution or countermanding need not be based on necessity but may be based on convenience.

If at any time it shall be, from the viewpoint of the Authority, impracticable or undesirable in the judgment of the Chief Engineer to proceed with or continue the performance of the Contract or any part thereof, whether or not for reasons beyond the control of the Authority, he shall have authority to suspend performance of any part or all of the Contract until such time as he may deem it practicable or desirable to proceed. Moreover, if at any time it shall be, from the viewpoint of the Authority impracticable or undesirable in the judgment of the Chief Engineer to proceed with or continue the performance of the Contract or any part thereof whether or not for reasons beyond the control of the Authority, he shall have authority to cancel this Contract as to any or all portions not yet performed and as to any materials not yet installed even though delivered. Such cancellation shall be without prejudice to the rights and obligations of the parties arising out of portions already performed, but no allowance shall be made for anticipated profits.

To resolve all disputes and to prevent litigation the parties to this Contract authorize the Chief Engineer to decide all questions of any nature whatsoever arising out of, under, or in connection with, or in any way related to or on account of, this Contract (including claims in the nature of breach of Contract or fraud or misrepresentation before or subsequent to acceptance of the Contractor's Proposal and claims of a type which are barred by the provisions of this Contract) and his decision shall be conclusive, final and binding on the parties. His decision may be based on such assistance as he may find desirable. The effect of his decision shall not be impaired or waived by any negotiations or settlement offers in connection with the question decided, whether or not he participated therein himself, or by any prior decision of the Engineer or others, which prior decisions shall be deemed subject to review, or by any termination or cancellation of this Contract provided, however, that notwithstanding the decision reached by the Chief Engineer in a review of determinations by the Assistant Chief Engineer for Construction or Engineer of Construction or Engineer that a particular item of Work is not Extra Work the Contractor shall be compensated therefor as provided in written orders of the Assistant Chief Engineer for Construction or Engineer of Construction or Engineer expressly and unmistakably indicating his intention to treat Work described therein as Extra Work issued in accordance with the provisions of the clause hereof entitled "Extra Work Orders" for amounts not in excess of $250,000.

All such questions shall be submitted in writing by the Contractor to the Chief Engineer for his decision, together with all evidence and other pertinent information in regard to such questions, in order that a fair and impartial decision may be made. In any action against the Authority relating to any such question the Contractor must allege in his complaint and prove such submission, which shall be a condition precedent to any such action. No evidence or information shall be introduced or relied upon in such an action that has not been so presented to the Chief Engineer.

This numbered clause shall be governed by and construed in accordance with the law of the State of New York, without giving effect to its choice of law provisions.

48. AUTHORITY AND DUTIES OF ENGINEER

In the performance of the Contract, the Contractor shall conform to all orders, directions and requirements of the Engineer and shall perform the Contract to the satisfaction of the Engineer at such times and places, by such methods and in such manner and sequence as he may require, and the Contract shall at all stages be subject to his inspection. The Engineer shall determine the amount, quality, acceptability and fitness of all parts of the Work and shall interpret Contract Drawings, Specifications and any orders for Extra Work. The Contractor shall employ no equipment, materials, methods or men to which the Engineer objects, and shall remove no materials, equipment or other facilities from the construction site without permission. Upon request, the Engineer shall confirm in writing any oral order, direction, requirements or determination.

The Contractor is requested to orally advise the Engineer of questions as they arise. Although such advice will not substitute for the written notice and information for which requirements are set forth elsewhere herein, it is anticipated that it will facilitate prompt decisions on the part of the Engineer and others.

The enumeration herein or in the Specifications of particular instances in which the opinion, judgment, discretion or determination of the Engineer shall control or in which the Contract shall be performed to his satisfaction or subject to his inspection, shall not imply that only the matters of a nature similar to those enumerated shall be so governed and performed, but without exception the entire Contract shall be so governed and so performed.

49. NOTICE REQUIREMENTS

No claim against the Authority shall be made or asserted in any action or proceeding at law or in equity, and the Contractor shall not be entitled to allowance of such claim, unless the Contractor shall have complied with all requirements relating to the giving of written notice of the information with respect to such claim as provided in this numbered clause. The failure of the Contractor to give such written notice and information as to any claim shall be conclusively deemed to be a waiver by the Contractor of such claim, such written notice and information being conditions precedent to such claim. As used herein "claim" shall include any claim arising out of, under, or in connection with, or in any way related to or on account of, this Contract (including claims in the nature of breach of Contract or fraud or misrepresentation before or subsequent to acceptance of the Contractor's Proposal and claims of a type which are barred by the provisions of this Contract) for damages, payment or compensation of any nature or for extension of any time for performance of any part of this Contract.

The requirements as to the giving of written notice and information with respect to claims shall be as follows:

A. In the case of any claims for Extra Work, extension of time for completion, idle salaried men and equipment, or any other matter for which requirements are set forth elsewhere in this Contract as to notice and information, such requirements shall apply.

B. In the case of all other types of claim, notice shall have been given to the Engineer, personally, as soon as practicable, and in any case, within 48 hours, after occurrence of the act, omission, or other circumstance upon which the claim is or will be based, stating as fully as practicable at the time all information relating thereto. Such information shall be supplemented with any further information as soon as practicable after it becomes or should become known to the Contractor, including daily records showing all costs which the Contractor may be incurring or all other circumstances which will affect any claim to be made, which records shall be submitted to the Engineer, personally.

The above requirements for notices and information are for the purpose of enabling the Authority to avoid waste of public funds by affording it promptly the opportunity to cancel or revise any order, change its plans, mitigate or remedy the effects of circumstances giving rise to a claim or take such other action as may seem desirable and to verify any claimed expense or circumstances as they occur, and the requirements herein for such notice and information are essential to this Contract and are in addition to any notice required by statute with respect to suits against the Authority.

The above referred to notices and information are required whether or not the Authority is aware of the existence of any circumstances which might constitute a basis for a claim and whether or not the Authority has indicated it will consider a claim.

No act, omission, or statement of any kind shall be regarded as a waiver of any of the provisions of this numbered clause or may be relied upon as such waiver except only either a written statement signed by the Executive Director of the Authority or a resolution of the Commissioners of the Authority expressly stating that a waiver is intended as to any particular provision of this numbered clause, and more particularly no discussion, negotiations, consideration, correspondence, or requests for information with respect to a claim by any Commissioner, officer, employee or agent of the Authority shall be construed as a waiver of any provision of this numbered clause or as authority or apparent authority to effect such a waiver.

Since merely oral notice or information may cause disputes as to the existence or substance thereof, and since notice, even if written, to other than the Authority representative above designated to receive it may not be sufficient to come to the attention of the representative of the Authority with the knowledge and responsibility of dealing with the situation only notice and information complying with the express provisions of this numbered clause shall be deemed to fulfill the Contractor's obligation under this Contract.

50. EQUAL EMPLOYMENT OPPORTUNITY - NEW YORK

During the performance of this Contract within the State of New York, the Contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color or national origin, and will take affirmative action to insure that they are afforded equal employment opportunities without discrimination because of race, creed, sex, color or national origin. Such action shall be taken with reference, but not be limited to: recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff or termination, rates of pay or other forms of compensation, and selection for training or retraining, including apprenticeship and on-the-job training.

B. The Contractor shall send to each labor union or representative of workers with which he has or is bound by a collective bargaining or other agreement or understanding, a notice, to be provided by the State Commission for Human Rights, advising such labor union or representative of the Contractor's agreement under A. through H. of this numbered clause (hereinafter called "non-discrimination requirements"). If the Contractor was directed to do so by the Authority as part of the bid or negotiation of this Contract, the Contractor shall request such labor union or representative to furnish him with a written statement that such labor union or representative will not discriminate because of race, creed, sex, color or national origin and that such labor union or representative either will affirmatively cooperate, within the limits of its legal and contractual authority, in the implementation of the policy and provisions of these non-discrimination requirements or that it consents and agrees that recruitment, employment, and the terms and conditions of employment under this Contract, shall be in accordance with the purposes and provisions of these non-discrimination requirements. If such labor union or representative fails or refuses to comply with such a request that it furnish such a statement, the Contractor shall promptly notify the State Commission for Human Rights of such failure or refusal.

C. The Contractor shall post and keep posted in conspicuous places, available to employees and applicants for employment, notices to be provided by the State Commission for Human Rights setting forth the substance of the provisions of A. and B. herein and such provisions of the State's laws against discrimination as the State Commission for Human Rights shall determine.

D. The Contractor shall state, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, that all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, sex, color or national origin.

E. The Contractor shall comply with the provisions of Sections 291-299 of the Executive Law and the Civil Rights Law, shall furnish all information and reports deemed necessary by the State Commission for Human Rights under these non-discrimination requirements and such sections of the Executive Law, and shall permit access to his books, records and accounts by the State Commission for Human Rights, the Attorney General and the Industrial Commissioner for the purposes of investigation to ascertain compliance with these non-discrimination requirements and such sections of the Executive Law and Civil Rights Law.

F. This Contract may be forthwith canceled, terminated or suspended, in whole or in part, by the Authority upon the basis of a finding made by the State Commission for Human Rights that the Contractor has not complied with these non-discrimination requirements, and the Contractor may be declared ineligible for future contracts made by or on behalf of the State, the Authority or other public authority or agency of the State, until he has satisfied the State Commission for Human Rights that he has established and is carrying out a program in conformity with the provisions of these non-discrimination requirements. Such finding shall be made by the State Commission for Human Rights after conciliation efforts by the Commission have failed to achieve compliance with these non-discrimination requirements and after a verified complaint has been filed with the Commission, notice thereof has been given to the Contractor by the Commission and an opportunity has been afforded him to be heard publicly before the State Commissioner of Human Rights or his designee. Such sanctions may be imposed and remedies invoked independently of or in addition to sanctions and remedies otherwise provided by law.

G. The Contractor shall include the provisions of A. through F. above in every subcontract or purchase order in such a manner that such provisions will be binding upon each subcontractor or vendor as to operations to be performed within the State of New York. The Contractor shall take such action in enforcing such provisions of such subcontract or purchase order as the Authority may direct, including sanctions or remedies for non-compliance. If the Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the Authority, the Contractor shall promptly so notify the General Counsel to the Authority, requesting him to intervene and protect the interests of the Authority.

H. The provisions of this numbered clause which refer to the State Commission for Human Rights, the Attorney General and the Industrial Commissioner are inserted in this Contract for the benefit of such parties, as well as for the benefit of the Authority, and said Commission, Commissioner and the Attorney General shall have a direct right of action against the Contractor to effectuate the intent of this clause.

51. EQUAL EMPLOYMENT OPPORTUNITY - NEW JERSEY

With respect to the performance of Work in the State of New Jersey and in order to conform with the policy of the Authority the Contractor agrees that the provisions of N.J.S.A. 10:2-1 through 10:2-4, dealing with discrimination in employment on public contracts, and the Rules and Regulations promulgated pursuant thereto, are hereby made a part of this Contract and are binding upon him and that it shall not be a defense to the Contractor in any action arising directly or indirectly out of such legislation and Rules and Regulations that the Authority may not be subject thereto.

The provisions of this numbered clause are for the benefit of the Attorney General of the State of New Jersey, Division on Civil Rights in the Department of Law and Public Safety of the State of New Jersey, and the Director thereof, as well as for the benefit of the Authority, and said Division and Director shall have a right of action against the Contractor to effectuate the intent of this clause.

52. NO DISCRIMINATION IN EMPLOYMENT

During the performance of this Contract within the State of New Jersey, the Contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicants for employment because of race, creed, color, national origin, sex, age, disability or marital status, and will undertake or continue existing programs of affirmative action to ensure that minority group persons are afforded equal employment opportunity without discrimination. Such programs shall include but not be limited to, recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff, termination, rates of pay or other forms of compensation, and selections for training or retraining, including apprenticeships and on-the-job training,

B. The Contractor shall request such employment agency, labor union, or authorized representative of workers with which it has a collective bargaining or other agreement or understanding and which is involved in the performance of the Contract to furnish a written statement that such employment agency, labor union or representative shall not discriminate because of race, creed, color, national origin, sex, age, disability or marital status and that such union or representative will cooperate in the implementation of the Contractor's obligations hereunder,

C. The Contractor will state, in all solicitations or advertisements for employees placed by or on behalf of the Contractor in the performance of the Contract with the Authority, that all qualified applicants will be afforded equal employment opportunity without discrimination because of race, creed, color, national origin, sex, age, disability or marital status,

D. The Contractor will include the provisions of A. through C. of this numbered clause in every subcontract or purchase order in such a manner that such provisions will be binding upon each subcontractor or vendor as to its work in connection with the Contract with the Authority,

E. The Contractor will submit to the Authority every two weeks a report indicating the number of workers employed at the construction site as of the lst and 15th days of each month and the projected number of workers to be so employed during the following month. This report shall also indicate the trade in which such workers are employed and, with respect to current employment (but not projected employment), shall indicate the number of such workers who are members of the following groups:

1.) Black persons having origins in any of the Black African racial groups not of Hispanic origin;

2.) Hispanic persons of Puerto Rican, Mexican, Dominican, Cuban, Central or South American culture or origin, regardless of race;

3.) Asian and Pacific Islander persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent or the Pacific Islands;

4.) American Indian or Alaskan Native persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification.

F. The Contractor agrees that he will fully cooperate with the office of the Attorney General of the State of New Jersey and with the Authority which seeks to deal with the problem of unlawful or invidious discrimination, and with all other State efforts to guarantee fair employment practices under this Contract, and said Contractor will comply promptly with all requests and directions from the Attorney General of the State of New Jersey and the Authority in this connection, both before and during construction.

G. Full cooperation as expressed in F. foregoing shall include, but not be limited to, being a witness or complainant in any proceeding involving questions of unlawful or invidious discrimination if such is deemed necessary by the Attorney General of the State of New Jersey, permitting employees of said Contractor to be witnesses or complainants in any proceeding involving questions of unlawful or invidious discrimination, if such is deemed necessary by the Attorney General of the State of New Jersey, signing any and all documents involved in any proceeding involving questions of unlawful or invidious discrimination, the execution of which are deemed necessary by the Attorney General of the State of New Jersey, participating in meetings, submitting periodic reports on the racial aspects of present and future employment, assisting in inspection at the construction site, and promptly complying with all State directives deemed essential by the Attorney General of the State of New Jersey to insure compliance with all Federal and State laws, regulations and policies against racial or other unlawful or invidious discrimination.

H. Upon the basis of a finding by the Attorney General of the State of New Jersey that the Contractor has not complied with these nondiscrimination requirements and that by reason thereof there has been a material breach of this Contract, the Executive Director of the Authority shall have the sole discretion and power to declare this Contract null and void upon 10 days' notice to the Contractor. In such event the Contractor shall become liable for any and all damages which shall accrue to the Authority including, but not limited to, the difference between the total cost of completion and the contract price under this Contract.

I. The provisions of this numbered clause which refer to the Attorney General are inserted in this Contract for the benefit of the Attorney General of the State of New Jersey as well as for the benefit of the Authority, and said Attorney General shall have a direct right of action against the Contractor to effectuate the intent of this clause.

53. AFFIRMATIVE ACTION REQUIREMENTS - EQUAL EMPLOYMENT OPPORTUNITY

The Contractor shall comply with the provisions set forth hereinafter. These provisions are modeled on the conditions for bidding on federal government contracts adopted by the Office of Federal Contract Compliance in 1978.

The Contractor and each subcontractor must fully comply with the clauses entitled "Equal Employment Opportunity - New York" and "Equal Employment Opportunity - New Jersey" and the requirements in this numbered clause. The Contractor commits himself to the goals for minority and female utilization set forth below and all other requirements, terms and conditions of this numbered clause by submitting a properly signed Proposal.

The Contractor shall appoint a company executive to assume the responsibility for the implementation of the requirements, terms and conditions of this numbered clause.

A. The goals for minority and female participation, expressed in percentage terms, for the Contractor's workforce at the construction site under this Contract are as follows:

Minority, except laborers	30%
Minority, laborers	40%
Female, except laborers	6.9%
Female, laborers	6.9%

These goals are applicable to all construction Work performed at the construction site under the Contract.

The Contractor's compliance with this numbered clause shall be based on his implementation of the clauses entitled "Equal Employment Opportunity - New York" and "Equal Employment Opportunity - New Jersey", and specific affirmative action obligations required herein of minority and female employment and training must be substantially uniform throughout the length of the Contract and in each trade. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract. Compliance with the goals will be measured against the total work hours performed.

B.

1.) The Contractor shall provide written notification to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under this Contract. The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated start and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

2.) The Contractor shall submit a Workforce Projection Schedule, which shall be correlated to the progress schedule, within thirty days after acceptance of the Contractor's Proposal, for the approval of the Engineer. The Contractor shall maintain and periodically update it at intervals as required by the Engineer. The Workforce Projection Schedule shall include the time period in which each trade shall be utilized, the average number of workers required per trade on a weekly basis, the peak period for each trade, and the number of workers required per trade for the peak period on a weekly basis.

C.

1.) As used in this numbered clause:

a. "Director" means Director, Office of Business Diversity and Civil Rights of the Authority;

b. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941;

c. "Minority" includes:

(i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(ii) Hispanic persons of Puerto Rican, Mexican, Dominican, Cuban, Central or South American culture or origin, regardless of race;

(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2.) Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the Work involving any construction trade, he shall physically include in each subcontract in excess of $10,000 such provisions as are necessary for the Contractor to achieve the aggregate goals set forth above.

3.) The Contractor shall implement the specific affirmative action standards provided in 6.) a. through p. hereof. The goals set forth above are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in the total workforce at the construction site under the Contract including employees of the Contractor and the subcontractors. The Contractor is expected to make substantially uniform progress toward his goals in each craft during the period specified. These goals may be achieved through utilization of journeyworkers and apprentices. In the event they are not achieved through the utilization of journeyworkers, the maximum number of apprentices provided for in the applicable collective bargaining agreement may be utilized to achieve said goals.

4.) Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations hereunder.

5.) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

6.) The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these provisions shall be based upon his effort to achieve maximum results from his actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or his unions have employment opportunities available, and maintain a record of the organizations' responses.

b. Develop maximum job opportunities for apprentices appropriate to the conditions of the Work and subject to the applicable collective bargaining agreement, in conjunction with training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 6.) a. above.

c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet his obligations.

e. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting his EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations hereunder with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and subcontractors with whom the Contractor does or anticipates doing business.

i. Direct his recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth.

k. Tests and other selection requirements shall comply with 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations hereunder are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

7.) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (6.) a. through p.). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of his obligations under 6.) a. through p. hereof provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet his individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's non-compliance.

8.) Goals for minorities and for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation hereof if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved his goals for women generally, the Contractor may be in violation hereof if a specific minority group of women is under-utilized).

9.) The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

10.) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

11.) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the clause entitled clauses entitled "Equal Employment Opportunity - New York" and "Equal Employment Opportunity - New Jersey", including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered by the Authority. Any Contractor who fails to carry out such sanctions and penalties shall be in violation hereof.

12.) The Contractor, in fulfilling his obligations hereunder shall implement specific affirmative action steps, at least as extensive as those standards prescribed in 6.) hereof so as to achieve maximum results from his efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of these provisions, the Authority shall proceed accordingly.

13.) The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports, including the Monthly Employment Utilization Report, relating to the provisions hereof as may be required and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g. mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

14.) Nothing herein provided shall be construed as a limitation upon the application of *any laws which establish standards of compliance or upon the application of* requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

54. PREVAILING RATE OF WAGE

The Contractor shall pay or provide (and shall cause all subcontractors to pay or provide) to his or their workmen, laborers and mechanics (who are employed by him or them to work on an hourly or daily basis at any trade or occupation at or about the construction site) at least the prevailing rate of wage and supplements for others engaged in the same trade or occupation in the locality in which the Work is being performed as determined by the Engineer.

For purposes of this Contract, the Engineer has determined that the prevailing rates of wage and supplements are those established by the Secretary of Labor of the United States pursuant to the Davis-Bacon Act (40 U.S.C.A. 276a) for the locality in which the Work is to be performed. The schedule of wages and supplemental benefits which are currently in effect is attached hereto. However, the applicable rates shall be those which are in effect on the date of opening of Proposals.

The provisions of this numbered clause are inserted in this Contract for the benefit of such workmen, laborers and mechanics as well as for the benefit of the Authority; and if the Contractor or any subcontractor shall pay or provide any such workman, laborer or mechanic less than the rates of wages and supplements above described, such workman, laborer or mechanic shall have a direct right of action against the Contractor or such subcontractor for the difference between the wages and supplements actually paid or provided and those to which he is entitled under this clause. If such workman, laborer or mechanic is employed by any subcontractor whose subcontract does not contain a provision substantially similar to the provisions of this clause (requiring the payment or provision of at least the above minimum, and providing for a cause of action in the event of the subcontractor's failure to pay or provide such wages and supplements) such workman, laborer or mechanic shall have a direct right of action against the Contractor. The Authority shall not be a necessary party to any action brought by any workman, laborer or mechanic to obtain a money judgment against the Contractor or any subcontractor pursuant to this numbered clause.

Nothing herein contained shall be construed to prevent the Contractor or any subcontractor from paying higher rates of wages or providing higher supplements than the minimum hereinbefore prescribed; and nothing herein contained shall be construed to constitute a representation or guarantee that the Contractor or any subcontractor can obtain workmen, laborers and mechanics for the minimum herein before prescribed. All wages actually paid that are in excess of the prevailing wages in the performance of Extra Work and Net Cost Work, if applicable, shall be subject, on each occasion, to the initial and continuing approval of the Engineer in advance of the performance of such Extra Work and Net Cost Work, if applicable.

The Contractor shall post at the Work site, in a place that is prominent, accessible and visible to all employees of the Contractor and his subcontractors during the daily time period that the Contractor and/or subcontractor performs Work at the site, the appropriate prevailing wage and supplement schedules. The Contractor must inform all employees, including those of his subcontractors, that they may obtain a copy of the prevailing wage and supplement schedule from the Contractor.

The Contractor and every subcontractor shall make and maintain weekly payroll records during the course of the Work and for the period set forth in the clause hereof entitled "Authority Access to Records" for all employees employed in the Work. Such records shall contain the name, address and last four digits of the social security number of each such employee (Contractors and subcontractors must maintain the full social security number of each employee and shall provide them upon request to the Port Authority Inspector General), the employee's correct payroll classification, rate of pay and supplements, daily and weekly number of hours worked, deductions made and actual wages and supplements paid. The Contractor shall submit these weekly payroll records to the Authority (on forms furnished by the Authority) of all his payroll records and those of each of his subcontractors as the Authority may require with the Contractor's monthly Payment Application, together with an affidavit by the Contractor and by each subcontractor to the effect that such payroll records are correct and complete, the wage and supplement rates contained therein are not less than those required by the provisions of this Contract, and the classifications set forth for each employee conform with the Work performed. Such copies and summaries and the original payroll records shall be available for inspection by the Authority (including its Inspector General), and the Contractor and his subcontractors shall permit such representatives to interview employees during Work hours at the construction site.

The Engineer may at any time request the Contractor to prepare a daily report on the Authority form entitled *Contractor Daily Sign-In Sheet*, copies of which can be obtained from the Engineer. The *Contractor Daily Sign-In Sheet* shall be completed as follows:

1.) At the beginning of each workday the Contractor shall:

a. fill in the top of the *Contractor Daily Sign-In Sheet*, including the location, date, contractor/subcontractor name and contract number;

b. ensure that each employee, including those of subcontractors, has printed and signed his or her name and indicated his or her work classifications, the last four digits of his or her social security number, and his or her starting time;

2.) At the end of each workday, the Contractor shall:

a. ensure that each employee, including those of subcontractors, has signed out and indicated his or her ending time;

b. sign the Certification Statement at the bottom of the form to indicate that the information contained in the *Contractor Daily Sign-In Sheet* is true and accurate; and

c. submit the original completed form to the Engineer's representative.

In an area of his office at the Site of the Work which is accessible to his employees, the Contractor shall display such printed material as may be provided by the Engineer setting forth information for the employees of the Contractor and his subcontractors concerning the wage and supplemental benefit requirements set forth in this numbered clause. The Contractor shall also cause each of his subcontractors to display such material in a similarly accessible place in any office which the subcontractor maintains at the Site of the Work.

The Contractor's failure to comply with any provision of this numbered clause shall be deemed a substantial breach of this Contract.

55. EXTRA WORK ORDERS

No Extra Work of a cost in excess of $250,000 shall be performed except pursuant to written orders of the Chief Engineer expressly and unmistakably indicating his intention to treat the Work described therein as Extra Work; and, no Extra Work of a cost of $250,000 or less shall be performed except pursuant to written orders of the Chief Engineer, Assistant Chief Engineer for Construction, Engineer of Construction or Engineer expressly and unmistakably indicating his intention to treat the Work described therein as Extra Work.

In the absence of such an order signed by the Chief Engineer in the case of Extra Work of a cost in excess of $250,000 and by the Chief Engineer or Assistant Chief Engineer for Construction or Engineer of Construction or Engineer in the case of Extra Work of a cost of $250,000 or less, if the Engineer shall direct, order or require any Work, whether orally or in writing, which the Contractor deems to be Extra Work, the Contractor shall nevertheless comply therewith, but shall within twenty-four (24) hours give written notice thereof to the Chief Engineer and the Engineer, stating why he deems it to be Extra Work, and shall moreover furnish to the Engineer time slips and memoranda as required by the clause hereof entitled "Compensation for Extra Work". Said notice, time slips and memoranda are for the purpose of affording to the Chief Engineer an opportunity to verify the Contractor's claim at the time and (if he desires so to do) to cancel promptly such order, direction or requirement of the Engineer, of affording to the Engineer an opportunity of keeping an accurate record of the materials, labor and other items involved, and generally of affording to the Authority an opportunity to take such action as it may deem desirable in light of the Contractor's claims. Accordingly, the failure of the Contractor to serve such notice or to furnish such time slips and memoranda shall be deemed to be a conclusive and binding determination on his part that the direction, order or requirement of the Engineer does not involve the performance of Extra Work, and shall be deemed to be a waiver by the Contractor of all claims for additional compensation or damages by reason thereof, such written notice, time slips and memoranda being a condition precedent to such claims.

56. PERFORMANCE OF EXTRA WORK

The provisions of this Form of Contract relating generally to Work and its performance shall apply without exception to any Extra Work required and to the performance thereof. Moreover, the provisions of the Specifications relating generally to the Work and its performance shall also apply to any Extra Work required and to the performance thereof, except to the extent that a written order in connection with any particular item of Extra Work may expressly provide otherwise.

57. TITLE TO MATERIALS

All materials to become part of the permanent construction shall be and become the property of the Authority upon delivery at the construction site or upon being especially adapted for use in or as a part of the permanent construction, whichever may first occur, subject however to the Contractor's assumption of risk under the clause hereof entitled "Risks Assumed by the Contractor", subparagraph A.

The Contractor shall promptly furnish to the Authority such bills of sale and other instruments as may be required by it, properly executed, acknowledged and delivered, assuring to it title to such materials, free of encumbrances and shall mark or otherwise identify all such materials as the property of the Authority.

58. ASSIGNMENTS AND SUBCONTRACTS

Any assignment or other transfer by the Contractor of this Contract or any part hereof or of any of his rights hereunder or of any monies due or to become due hereunder and any delegation of any of his duties hereunder without the express consent in writing of the Authority shall be void and of no effect as to the Authority, provided, however, that the Contractor may subcontract portions of the Work to such persons as the Engineer may, from time to time, expressly approve in writing. For each individual, partnership or corporation proposed by the Contractor as a subcontractor, the Contractor shall submit to the Authority a certification or, if a certification cannot be made, a statement by such person, partnership or corporation to the same effect as the certification or statement required from the Contractor pursuant to the clauses of the "Information For Bidders" entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, Etc; Disclosure of Other Required Information", "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee" and "Certification of Participation in a State-Registered or United States Department of Labor-Registered Apprenticeship Program". The Certification of Participation in a State-Registered or United States Department of Labor-Registered Apprenticeship Program shall only be applicable to each subcontractor whose total amount of subcontract under this Contract is greater than $1 million. All further subcontracting by any subcontractor shall also be subject to such approval of the Engineer. Approval of a subcontractor may be conditioned on (among other things) the furnishing, without expense to the Authority, of a surety bond guaranteeing payment by the subcontractor of claims of materialmen, subcontractors, workmen and other third persons arising out of the subcontractor's performance of any part of the Work. Approval of a subcontractor may be rescinded for, among other things, failure of the Contractor to furnish the subcontractor's certificate of insurance, as required by the Form of Contract clause entitled "Insurance Procured by Contractor", within the time set forth in said clause.

No consent to any assignment or other transfer, and no approval of any subcontractor, shall under any circumstances operate to relieve the Contractor of any of his obligations; no subcontract, no approval of any subcontractor and no act or omission of the Authority or the Engineer shall create any rights in favor of such subcontractor and against the Authority; and as between the Authority and the Contractor, all assignees, subcontractors, and other transferees shall for all purposes be deemed to be agents of the Contractor. Moreover, all subcontracts and all approvals of subcontractors shall be and, regardless of their form, shall be deemed to be conditioned upon performance by the subcontractor in accordance with this Contract; and if any subcontractor shall fail to perform the Contract to the satisfaction of the Engineer, the Engineer shall have the absolute right to rescind his approval forthwith and to require the performance of the Contract by the Contractor personally or through other approved subcontractors.

59. CLAIMS OF THIRD PERSONS

The Contractor undertakes to pay all claims lawfully made against him by subcontractors, materialmen and workmen, and all claims lawfully made against him by other third persons arising out of or in connection with or because of the performance of this Contract and to cause all subcontractors to pay all such claims lawfully made against them.

60. CERTIFICATES OF PARTIAL COMPLETION

If at any time prior to the rendition of the Certificate of Final Completion, any portion of the permanent construction has been satisfactorily completed, and if in the judgment of the Engineer such portion of the permanent construction is not necessary for the operations of the Contractor but will be immediately useful to and is needed by the Authority for other purposes, the Engineer may render to the Authority and to the Contractor a certificate in writing to that effect (herein called a Certificate of Partial Completion), and thereupon or at any time thereafter the Authority may take over and use the portion of the permanent construction described in such Certificate and exclude the Contractor therefrom.

The rendition of a Certificate of Partial Completion shall not be construed to constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates in the event that he has failed to complete the same in accordance with the terms of this Contract. Moreover, the acceptance of a Certificate of Partial Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

61. CERTIFICATE OF SUBSTANTIAL COMPLETION

Prior to the rendition of the Certificate of Final Completion, the Engineer may deem the entire Work to be substantially completed when, in the judgment of the Engineer, the permanent construction has been satisfactorily completed to the point where the Work is fit for its intended purpose and use. The Engineer may, if such a determination of substantial completion is made and at such time, render to the Authority and to the Contractor a certificate in writing to that effect (herein called the Certificate of Substantial Completion), and thereupon or at any time thereafter the Authority may take over and use the permanent construction described in such Certificate and exclude the Contractor therefrom. Whether to make a determination of a substantial completion as to any portion of the Work, and whether to render such a Certificate, shall be the discretionary determination of the Engineer based upon an examination and appraisal of the completed Work, and no right to such a determination or certification is established in the Contractor by this provision.

The rendition of such Certificate of Substantial Completion shall not relieve the Contractor of his obligation hereunder to complete the Work of this Contract nor shall it be construed to constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates in the event that he has failed to complete the same in accordance with the terms of this Contract. Moreover, the acceptance of a Certificate of Substantial Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

When the Contractor is of the opinion that the Work is substantially complete as described above, the Contractor may submit to the Engineer a written request that the Engineer inspect the Work so as to determine, in the Engineer's sole opinion, whether substantial completion has been achieved. The Contractor's written request shall list the specific items of Work that are incomplete. Upon such a request, the Engineer will respond within 30 days with a Certificate of Substantial Completion or provide a written explanation of the reasons why the Work is not substantially complete including a list of open items necessary to achieve substantial completion. Nothing contained herein shall be deemed to preclude the Engineer from making a determination of substantial completion in the absence of a request therefor by the Contractor.

62. CERTIFICATE OF FINAL COMPLETION

After the satisfactory completion of all Work whatsoever required and the making of such tests and inspections as may be necessary or desirable, the Engineer shall render to the Authority and to the Contractor a certificate in writing (herein called the Certificate of Final Completion) certifying that in his opinion all Work under this Contract including Extra Work, has been completed in accordance with the Contract Drawings and Specifications and the requirements of the Engineer, and certifying the date as of which it was so completed.

The rendition of the Certificate of Final Completion shall not be construed to constitute an extension of the Contractor's time for performance in the event that he has failed to complete the Work in accordance with the terms of this Contract. Moreover, the acceptance of the Certificate of Final Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

As a condition precedent to rendition of the Certificate of Final Completion, the Contractor shall submit the "Summary of Asbestos Removal and Disposal Costs" in accordance with the Section of Division 1 - GENERAL PROVISIONS entitled "Asbestos Cost Summary Submittal".

63. NO GIFTS, GRATUITIES, OFFERS OF EMPLOYMENT, ETC.

During the term of this Contract, the Contractor shall not offer, give or agree to give anything of value either to an Authority employee, agent, job shopper, consultant, construction manager or other person or firm representing the Authority, or to a member of the immediate family (i.e, a spouse, child, parent, brother or sister) of any of the foregoing, in connection with the performance by such employee, agent, job shopper, consultant, construction manager or other person or firm representing the Authority of duties involving transactions with the Contractor on behalf of the Authority, whether or not such duties are related to this Contract or any other Authority contract or matter. Any such conduct shall be deemed a material breach of this Contract.

As used herein "anything of value" shall include but not be limited to any (a) favors, such as meals, entertainment, transportation (other than that contemplated by the Contract or any other Authority contract), etc., which might tend to obligate the Authority employee to the Contractor, and (b) gift, gratuity, money, goods, equipment, services, lodging, discounts not available to the general public, offers or promises of employment, loans or the cancellation thereof, preferential treatment or business opportunity. Such term shall not include compensation contemplated by this Contract or any other Authority contract.

Where used in this clause, the term "Authority" shall be deemed to include all subsidiaries of the Authority. Currently, those subsidiaries are the Port Authority Trans-Hudson Corporation (PATH), the Newark Legal and Communications Center and the New York and New Jersey Railroad Corporation.

In addition, during the term of this Contract, the Contractor shall not make an offer of employment or use confidential information in a manner proscribed by the Code of Ethics and Financial Disclosure dated as of April 11, 1996 (a copy of which is available upon request to the Office of the Secretary of the Authority).

The Contractor shall include the provisions of this clause in each subcontract entered into under this Contract.

CHAPTER V

WARRANTIES MADE AND LIABILITY

ASSUMED BY THE CONTRACTOR

64. CONTRACTOR'S WARRANTIES

The Contractor represents and warrants:

A. That he is financially solvent, that he is experienced in and competent to perform the type of services contemplated by this Contract, that the facts stated or shown in any papers submitted or referred to in connection with his Proposal are true, and, if the Contractor be a corporation, that it is authorized to perform this Contract;

B. That he has carefully examined and analyzed the provisions and requirements of this Contract and inspected the construction site, that from his own investigations he has satisfied himself as to the nature of all things needed for the performance of this Contract, the general and local conditions and all other matters which in any way affect this Contract or its performance, and that the time available to him for such examination, analysis, inspection and investigations was adequate;

C. That the Contract is feasible of performance in accordance with all its provisions and requirements and that he can and will perform it in strict accordance with such provisions and requirements;

D. That no Commissioner, officer, agent or employee of the Authority is personally interested directly or indirectly in this Contract or the compensation to be paid hereunder; and

E. That, except only for those representations, statements or promises expressly contained in this Contract, no representation, statement or promise, oral or in writing, of any kind whatsoever by the Authority, its Commissioners, officers, agents, employees or consultants has induced the Contractor to enter into this Contract or has been relied upon by the Contractor, including any with reference to: (1) the meaning, correctness, suitability, or completeness of any provisions or requirements of this Contract; (2) the nature, existence or location of materials, structures, obstructions, utilities or conditions, surface or subsurface, which may be encountered at the construction site; (3) the nature, quantity, quality or size of the materials, equipment, labor and other facilities needed for the performance of this Contract; (4) the general or local conditions which may in any way affect this Contract or its performance; (5) the price of the Contract; or (6) any other matters, whether similar to or different from those referred to in (1) through (5) immediately above, affecting or having any connection with this Contract, the bidding thereon, any discussions thereof, the performance thereof or those employed therein or connected or concerned therewith.

Moreover, the Contractor accepts the conditions at the construction site as they may eventually be found to exist and warrants and represents that he can and will perform the Contract under such conditions and that all materials, equipment, labor and other facilities required because of any unforeseen conditions (physical or otherwise) shall be wholly at his own cost and expense, unless specifically provided for elsewhere in this Contract.

Nothing in the Contract Drawings or Specifications or any other part of the Contract is intended as or shall constitute a representation by the Authority as to the feasibility of performance of this Contract or any part thereof. Moreover, the Authority does not warrant or represent either by issuance of the Contract Drawings and Specifications or by any provision of this Contract as to time for performance or completion or otherwise that the Contract may be performed or completed by the times required herein or by any other times.

The Contractor further represents and warrants that he was given ample opportunity and time and by means of this paragraph was requested by the Authority to review thoroughly all documents forming this Contract prior to opening of Proposals on this Contract in order that he might request inclusion in this Contract of any statement, representation, promise or provision which he desired or on which he wished to place reliance; that he did so review said documents, that either every such statement, representation, promise or provision has been included in this Contract or else, if omitted, that he expressly relinquishes the benefit of any such omitted statement, representation, promise or provision and is willing to perform this Contract without claiming reliance thereon or making any other claim on account of such omission.

The Contractor further recognizes that the provisions of this numbered clause (though not only such provisions) are essential to the Authority's consent to enter into this Contract and that without such provisions, the Authority would not have entered into this Contract.

65. RISKS ASSUMED BY THE CONTRACTOR

The Contractor assumes the following distinct and several risks, whether they arise from acts or omissions (whether negligent or not) of the Contractor, of the Authority, or of third persons, or from any other cause, and whether such risks are within or beyond the control of the Contractor, excepting only risks which arise solely from affirmative acts done by the Authority subsequent to the opening of Proposals on this Contract with actual and wilful intent to cause the loss, damage and injuries described in subparagraphs A through D below:

A. The risk of loss or damage to the permanent construction prior to the rendition of the Certificate of Final Completion (other than loss or damage to the portions of the permanent construction with respect to which Certificates of Partial Completion have been issued), and the Contractor shall forthwith repair, replace and make good any such loss or damage to the permanent construction without cost to the Authority;

B. The risk of loss, damage to or alterations of the structures to be demolished occurring prior to completion of demolition by the Contractor (such structures being still included, however, in the term "Work"). In the event of such loss, damage or alterations, the Contractor shall nevertheless complete the performance of the Work, including the demolition, without additional cost to the Authority and without compensation for lost salvage value;

C. The risk of claims, fines or penalties, just or unjust, made by third persons or assessed by courts or governmental agencies or entities against the Contractor or the Authority on account of injuries (including wrongful death), loss, damage or liability of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work (whether or not actually caused by or resulting from the performance of the Work) or out of or in connection with the Contractor's operations or presence at or in the vicinity of the construction site or Authority premises, including claims against the Contractor or the Authority for the payment of workers' compensation, whether such claims, fines or penalties are made or assessed and whether such injuries, damage, loss and liability are sustained at any time both before and after the rendition of the Certificate of Final Completion;

D. The risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the Authority for loss or damage to any property of subcontractors, materialmen, workmen and others performing the Work, occurring at any time prior to completion of removal of such property from the construction site or Authority premises or the vicinity thereof.

The Contractor shall indemnify the Authority against all claims described in subparagraphs C and D above and for all expense incurred by it in the defense, settlement or satisfaction thereof, including expenses of attorneys, except where indemnity would be precluded by New York State General Obligations Law, Section 5-322.1 or by other applicable law. If so directed, the Contractor shall defend against any claim described in subparagraphs C and D above, in which event he shall not without obtaining express advance permission from the General Counsel of the Authority raise any defense involving in any way jurisdiction of the tribunal, immunity of the Authority, governmental nature of the Authority or the provisions of any statutes respecting suits against the Authority . Unless a claim is one which the Contractor is not required to indemnify the Authority against as described in the first sentence of this paragraph, such defense shall be at the Contractor's cost.

The provisions of this numbered clause shall also be for the benefit of the Commissioners, officers, agents and employees of the Authority, so that they shall have all the rights which they would have under this numbered clause if they were named at each place above at which the Authority is named, including a direct right of action against the Contractor to enforce the foregoing indemnity, except, however, that the Authority by action of its Board of Commissioners may at any time in its sole discretion and without liability on its part cancel the benefit conferred on any of them by this numbered clause, whether or not the occasion for invoking such benefit has already arisen at the time of such cancellation.

Neither the issuance of a Certificate of Completion nor the making of Final Payment shall release the Contractor from his obligations under this numbered clause. Moreover, neither the enumeration in this numbered clause nor the enumeration elsewhere in this Contract of particular risks assumed by the Contractor or of particular claims for which he is responsible shall be deemed (a) to limit the effect of the provisions of this numbered clause or of any other clause of this Contract relating to such risks or claims, (b) to imply that he assumes or is responsible for risks or claims only of the type enumerated in this numbered clause or in any other clause of this Contract, or (c) to limit the risks which he would assume or the claims for which he would be responsible in the absence of such enumerations.

The provisions of this numbered clause shall not be impaired by any rights the Contractor might otherwise have to limitation or apportionment of damages under the law of admiralty or to limitation of liability under 33 U.S.C.A. Chapter 9 (Protection of Navigable Waters and of Harbor and River Improvements), 46 U.S.C.A. Chapter 8 (Limitation of Vessel Owner's Liability), and any other similar statutes, and as between the Contractor and the Authority, the Contractor hereby waives any such rights. Moreover, the Contractor also waives any rights to limitation of liability under such law or statutes in connection with damage which may occur to property of the Authority arising out of or in connection with performance of the Contract whether the right to recover for such damage arises under this Contract or otherwise.

66. NO THIRD PARTY RIGHTS

Nothing contained in this Contract is intended for the benefit of third persons, except to the extent that the Contract specifically provides otherwise by use of the words "benefit" or "direct right of action".

67. INSURANCE PROCURED BY THE AUTHORITY

In order to reduce the cost of this Contract, the Authority will procure and will maintain in force and pay the premiums on:

A. A policy of public liability (Comprehensive - Commercial General Liability, including Contractual) insurance on which the Contractor and the subcontractors will be insureds issued by an insurance company satisfactory to the Authority, with current coverage limits of $50 million per occurrence for bodily injury and property damage liability.

B. A policy of workers' compensation and employer's liability insurance fulfilling the Contractor's and the subcontractor's obligations under the applicable State Workers' Compensation Law for those employees of the Contractor and the subcontractors employed pursuant to this Contract in operations conducted at the site of the Work hereunder. Coverage under this policy may, as appropriate, include one or more of the following endorsements:

1.) Longshore and Harbor Workers' Compensation Act Coverage Endorsement. (Applies when performing work on or around navigable waters).

2.) Maritime Coverage Endorsement (Applies to masters or members of the crews of vessels, if vessels are used).

3.) Federal Employer's Liability Act Coverage Endorsement. (May apply to railroad related Work).

Determination in any instance as to the appropriateness of the included coverage described in B.1, 2 and 3 above will be made based upon information to be provided by the Contractor relating to the mode of performance of Work to be done under the Contract.

The policy described in B above will not provide coverage for any workers' compensation for the Contractor and/or subcontractors who perform any asbestos work. In such cases, the Contractor or subcontractors shall procure and maintain, at their own expense, the workers' compensation insurance in accordance with the requirements of law in the state(s) where the Work will take place, including employer's liability insurance (in limits of not less than $1 million per occurrence).

Should the Contractor and/or subcontractors be required to procure the workers' compensation insurance, within ten days after the acceptance of his Proposal the Contractor shall deliver to the General Manager, Risk Financing, The Port Authority of NY & NJ, Treasury Department, 225 Park Avenue South, 12th Floor, New York, N.Y. 10003 (Attn: Contract Insurance Review), an original certificate, stating the Contract number, from the insurer. A duplicate certificate evidencing the above insurance shall also be delivered to the Engineer. With regard to insurance required to be procured by a subcontractor, the Contractor shall deliver the certificate described above at least ten days before the subcontractor commences Work.

The requirements for insurance procured by the Contractor or subcontractors shall not in any way be construed as a limitation on the nature or extent of the obligations of the Contractor or subcontractors.

C. A policy of builder's risk insurance, covering the improvements or other Work to be effectuated by the Contractor and the subcontractors, with coverage limits of $50 million per occurrence for all locations combined (subject to a $50 million annual aggregate for flood and earthquake damage and a limit of $10 million per occurrence for damage to off-site storage and property in-transit). The deductible is $10,000 per occurrence for all losses except those caused by flood and earthquake, where a $50,000 deductible per occurrence with respect to flood, and a $25,000 deductible per occurrence with respect to earthquake are in effect. The policy form contains various exclusions, including but not limited to the following property exclusions: automobiles; aircraft; and Contractor's and subcontractors' machinery, tools, and equipment and property of a similar nature, including forms, shoring, scaffolding, temporary structures, rental property/equipment and similar property, not intended to become a permanent part of a building or structure. The Contractor and the subcontractors must refer to the policy form to determine all properties and perils included and excluded and to determine their rights and responsibilities as insureds under the policy form. The Contractor and the subcontractors are responsible for payment for all losses within the deductibles and losses not covered by the builder's risk policies.

The current policies described in A, B and C of this numbered clause are available for examination by appointment in the office of the General Manager, Risk Financing, The Port Authority of NY & NJ, Treasury Department, 225 Park Avenue South, 12th Floor, New York, N.Y. 10003. The policies under A above are subject to certain liability coverage exclusions, which include, but are not limited to, exclusions from liability from claims arising from pollution and exposure to asbestos.

The Contractor and subcontractors shall comply with all obligations of the insured under or in connection with all of the policies described in A, B and C above.

The Authority shall have the right at any time and from time to time at its option to procure insurance substituting in whole or in part for any or all of the policies described in A, B and C above or to require that the Contractor and the subcontractors themselves obtain insurance substituting in whole or part for that above referred to, provided always, however, that the Contractor and the subcontractors shall be afforded coverage as stipulated by the Authority and the Authority shall either pay the premiums on such substitute insurance or reimburse the Contractor and the subcontractors therefor.

Neither the procurement of the above insurance or any substitute insurance nor the extent of the coverage or the limits of liability thereunder shall be construed to be a limitation on the nature or extent of the Contractor's obligations, or to relieve the Contractor of any such obligations, and the procurement of the above insurance is only for the purpose of reducing the cost of the Contract without constituting any representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on the Contractor by law (except the applicable State Workers' Compensation Law) or by this or any other contract.

Notwithstanding any provision of this clause, however, no subcontractor shall be or have the right to be covered under the policies of insurance above referred to until the subcontractor has been expressly approved in writing by the Engineer, as required under this Contract, and such approval may be withheld, among other reasons, until execution by the subcontractor of agreements affirming his obligations provided in this clause with respect to the above insurance.

The provisions of this numbered clause are not intended to create any rights for the Contractor other than rights which may be available to the Contractor under said policies themselves, whatever such rights may be. Moreover, the Authority makes no representation or guaranty, either by the provisions of this numbered clause or otherwise, as to the effect of or the coverage under said policies, and no employee or agent of the Authority is authorized to make any such representation or guaranty, either by the provisions of this numbered clause or otherwise, as to the effect of or the coverage under said policies, and no employee or agent of the Authority is authorized to make any such representation or guaranty or to offer any interpretation of or information on said policies. The Contractor warrants and represents that he has examined and is familiar with the above stated coverages and that in submitting his Proposal he has relied solely on his own interpretation thereof and not on any representations or statements, oral or written, of the Authority, its Commissioners, officers, agents, employees, consultants or contractors.

All negotiations and adjustments with any insurer concerning payment for any loss, the risk of which is borne by the Contractor under this Contract, shall be the responsibility of and shall be conducted by the Contractor unless the applicable policy provides otherwise. The Contractor shall, however, inform the Engineer of the progress of all such negotiations and notify the Engineer sufficiently in advance of all meetings thereon so that the Engineer or designated representatives may attend said negotiations if they so desire.

The Authority shall be entitled to all returned premiums, dividends and credits which may become payable at any time for any reason whatsoever in connection with the aforementioned insurance. The Contractor hereby assigns to the Authority all such returned premiums, dividends and credits and the subcontractors shall be deemed to have assigned to the Authority all such returned premiums, dividends and credits by becoming subcontractors under this Contract. The Contractor shall execute and cause the subcontractors to execute any instrument necessary or convenient to evidence the Authority's right to such returned premiums, dividends and credits.

Notwithstanding any payment by the Authority of any insurance premiums, the Authority shall not be deemed the employer of any employees hired by the Contractor or any subcontractor covered by such insurance nor shall it be liable for any of the obligations of such employer.

The Contractor and the subcontractors shall cooperate to the fullest extent with the Authority in all matters relating to the aforementioned insurance and shall comply with all requirements of all insurance policies procured by the Authority. They shall also at their own expense furnish the Engineer or a duly authorized representative with copies of all payrolls, correspondence, papers, records and other things necessary or convenient for dealing with or defending against any claims and for procuring or administering the aforementioned insurance including furnishing the name of any of their employees, officers, or agents whose presence or testimony is necessary or convenient in any negotiations or proceedings involving such insurance.

68. INSURANCE PROCURED BY CONTRACTOR

The Contractor, and all subcontractors, shall maintain and pay the premiums on the policy or policies of insurance for coverage(s) as hereinafter described, which shall cover their operations hereunder, shall be effective throughout the effective period of this Contract, and shall afford coverage(s) in not less than the amounts set forth below:

A. Commercial Automobile Liability Insurance: covering "any" vehicles on the broadest commercially available form:

1.) Combined single limit for bodily injury and property damage liability - $5 million per each accident.

2.) Hazardous/contaminated waste transportation insurance shall be provided by any Contractor or subcontractor hauling hazardous/contaminated waste with a limit of $5 million each occurrence.

B. Environmental Liability Insurance:

The Contractor shall procure and maintain in force an Environmental Liability Insurance Policy covering the Contractor's pollution legal liability, including cleanup, with limits not less than $5 million per occurrence for bodily injury and property damage tailored to the specific exposures as they relate to the Work of this Contract. The policy will be in effect commencing on or about the date of the Authority's acceptance of the Contractor's Proposal.

Such policy and any certificate of insurance submitted hereunder in relation to such policy shall (I) be expressly endorsed for each Authority facility under this Contract and each transfer location, travel route and material disposition location selected by the Contractor, (II) state that claims disputes and coverage shall be litigated in United States courts having jurisdiction, and not be limited to arbitration, and (III) acknowledge the Contractor's disclosure to the insurance carrier that the material may be considered a hazardous substance/waste under applicable law including, but not limited to, RCRA and/or CERCLA and/or the Toxic Substance Control Act (TSCA). It should be noted that the substances may be considered "hazardous" under CERCLA, but not necessarily "hazardous" under RCRA and that such materials if RCRA "hazardous" would require a manifest and disposal certificate under RCRA at a Subtitle C hazardous waste disposal facility. A copy of this Contract, including all schedules and documents attached hereto, shall be provided to the insurance carrier.

C. Lead Abatement Liability Insurance

The Contractor shall procure Lead Abatement Liability Insurance, on an occurrence basis, with a limit of liability of $5 million /occurrence and $5 million /aggregate. The Policy shall include the Authority and all subcontractors as additional insureds. The policy shall include coverage for environmental cleanup on land and on water. The policy shall be endorsed to include coverages for premises-operation, products-completed operations (for 2 years after the completion of the Contract), broad form property damage, independent contractors, personal injury, blanket contractual liability in accordance with ISO policy form GG 00 01 1185. The policy shall not contain a sunset provision, commutation clause, or any other provision which would prohibit the reporting of a claim and the subsequent defense and indemnify that would normally be provided by the policy. Self-funded, policy fronting, or other non-risk transfer insurance mechanisms are not acceptable tothe Authority, unless full disclosure is made to the Authority prior to any consideration being given. The liability of the Contractor shall not be limited in any manner to the provision of coverages of applicable limits of liability contained within any section of the Contract. The Authority shall be provided a waiver of subrogation.

The policy shall provide transportation coverage for the hauling of lead based paint from the construction site to the final disposition location. Deductibles shall not reduce the limit of liability. The policy shall have coverage for cross-liability/severability of interest. The policy form must "pay on behalf of" rather than "indemnify the insured". If the policy or any endorsement contains a provision which limits or eliminates bodily injury or property damage coverage based on airborne lead levels, the policy shall be modified so that it is consistent with environmental/monitoring requirements for lead as contained in the Contract Specifications and inclusive of 40 CFR50, Appendix G, and the appropriate analytical testing protocol contained in the Contract Specifications. The Contractor's insurance shall be primary insurance as respects the Authority, its representatives, officials and employees. Any insurance or self-insurance maintained by the Authority shall be excess of this insurance and shall not contribute with it. The policy shall provide pollution coverage as respects lead-based paint for all phases of the abatement process. The policy shall not contain any provision or definition that would serve to eliminate third party over-claims, including exclusions of the premises owner. The policy must be modified to include, "The insolvency or bankruptcy of the insured or of the insured's estate will not relieve the insurance company of its obligations under this policy".

D. Protection and Indemnity Insurance

If watercraft is to be used, the Contractor shall take out, maintain and pay the premiums on a policy of Marine Protection and Indemnity Insurance (that will "pay on behalf of" basis) and Chartered Legal Liability, where applicable, or similar watercraft coverage, relating to the operation, maintenance or use of any vessel (whether self-propelled or being towed) in connection with work to be performed under this Contract, in a limit of liability of not less than $5 million for any one occurrence.

E. Professional Liability Insurance

The Contractor shall, and/or shall cause its subcontractor(s) to procure, maintain and pay at their own expense a policy of professional liability insurance of not less than $ 5 million each occurrence covering acts, errors, omissions, breaches of professional obligations, mistakes and malpractice arising out of work or services performed of a professional nature under this Contract. All endorsements and exclusions shall be evidenced on the certificate of insurance. The coverage shall be written on an occurrence form or may be written on a claims-made basis provided that coverage shall be maintained to cover all claims with a minimum of a five year reporting/discovery period

The Port Authority of New York and New Jersey and its related entities shall be named as an additional insured in the liability policy or policies and evidenced by the certificate(s) of insurance set forth above. The liability policy(ies) and the certificate(s) of insurance shall show coverage for cross-liability/severability of interests as provided under the standard ISO "separation of insureds" condition.

The Contractor shall deliver certified copies of the policy(ies) described above or certificate(s) of insurance evidencing the existence thereof to the Engineer at the location where the Work will be performed, within ten (10) days after the acceptance of his Proposal. Such policy(ies) or certificate(s) shall state the Contract number and shall contain a valid provision or endorsement that the policy(ies) may not be canceled, terminated, changed or modified without giving thirty (30) days written advance notice thereof to the Authority.

Such policy(ies) and certificate(s) of insurance shall contain an additional endorsement providing that "the insurance carrier shall not, without obtaining express advance permission from the General Counsel of the Authority, raise any defense involving in any way the jurisdiction of the Tribunal over the person of the Authority, the immunity of the Authority, its Commissioners, officers, agents or employees, the governmental nature of the Authority or the provisions of any statutes respecting suits against the Authority".

Certified copies of all renewal policies or certificates evidencing their existence shall be delivered to the Engineer at the location where the Work will be performed at least ten (10) days prior to the expiration date of each expiring policy. If at any time any of the certificates or policies shall be or become unsatisfactory to the Authority as to form or substance, or if the carrier issuing any such certificate or policy shall be or become unsatisfactory to the Authority, the Contractor shall promptly obtain a new and satisfactory certificate and policy. Upon request of the General Manager, Risk Financing, the Contractor shall furnish the Authority with a certified copy of each policy stated above.

The requirements for insurance procured by the Contractor shall not in any way be construed as a limitation on the nature or extent of the contractual obligations assumed by the Contractor under this Contract. The insurance requirements are not a representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on him by law or by this or any other contract.

CHAPTER VI

RIGHTS AND REMEDIES

69. RIGHTS AND REMEDIES OF AUTHORITY

The Authority shall have the following rights in the event the Chief Engineer shall deem the Contractor guilty of a breach of any term whatsoever of this Contract:

A. The right to take over and complete the Work or any part thereof as agent for and at the expense of the Contractor, either directly or through other contractors.

B. The right to cancel this Contract as to any or all of the Work yet to be performed.

C. The right to specific performance, an injunction or any other appropriate equitable remedy.

D. The right to money damages.

For the purpose of this Contract, breach shall include but not be limited to the Contractor's failure to procure insurance satisfactory to the Authority within the time limit specified in the Clause hereof entitled "Insurance Procured by Contractor" and the following, whether or not the time has yet arrived for performance of an obligation under this Contract: a statement by the Contractor to any representative of the Authority indicating that he cannot or will not perform any one or more of his obligations under this Contract; any act or omission of the Contractor or any other occurrence which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any suspension of or failure to proceed with any part of the Work by the Contractor which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any false certification at any time by the Contractor as to any material item certified pursuant to the clauses of the Information For Bidders entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, Etc; Disclosure of Other Required Information", "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee", and "Certification of Participation in a State-Registered or United States Department of Labor-Registered Apprenticeship Program", any false certification at any time by the Contractor or a subcontractor pursuant to the clause "Prevailing Rate of Wage Certification" set forth in the Information for Bidders, or the willful or fraudulent submission of any signed statement pursuant to such clauses which is false in any material respect; or the Contractor's incomplete or inaccurate representation of its status with respect to the circumstances provided for in such clauses.

The enumeration in this numbered clause or elsewhere in this Contract of specific rights and remedies of the Authority shall not be deemed to limit any other rights or remedies which the Authority would have in the absence of such enumeration; and no exercise by the Authority of any right or remedy shall operate as a waiver of any other of its rights or remedies not inconsistent therewith or to estop it from exercising such other rights or remedies.

70. RIGHTS AND REMEDIES OF CONTRACTOR

Inasmuch as the Contractor can be adequately compensated by money damages for any breach of this Contract which may be committed by the Authority, the Contractor expressly agrees that no default, act or omission of the Authority shall constitute a material breach of this Contract, entitling him to cancel or rescind it or (unless the Engineer shall so direct) to suspend or abandon performance.

71. PERFORMANCE OF WORK AS AGENT FOR CONTRACTOR

In the exercise of its right to take over and complete Work as agent for the Contractor, for which provision is made in the clause hereof entitled "Rights and Remedies of Authority", the Authority shall have the right to take possession of and use or permit the use of any and all plant, materials, equipment and other facilities provided by the Contractor for the purpose of the Work and the Contractor shall not remove any of the same from the site of the Work without express permission. Unless expressly directed to discontinue the performance of all Work, the Contractor shall continue to perform the remainder thereof in such manner as in no way will hinder or interfere with the portions taken over by the Authority.

In the certificate of total compensation earned, for which provision is made in the clause hereof entitled "Final Payment", the Engineer will separately state the amount of Work performed by the Authority as agent for the Contractor, credit to the Authority the cost thereof, and credit to the Contractor the compensation earned thereby; and the difference between them shall be payable by the Contractor to the Authority, or vice versa as the case may be. If such difference is in its favor, the Authority may deduct it from any moneys due the Contractor, and if such moneys be insufficient, the balance thereof shall be payable to it on demand; if in the Contractor's favor, it shall constitute part of the Final Payment.

The exercise by the Authority of its right to take over the Work shall not release the Contractor or his sureties from any of his or their obligations or liabilities under this Contract or the Performance and Payment Bond.

72. NO ESTOPPEL OR WAIVER

The Authority shall not be precluded or estopped by any acceptance, certificate or payment, final or otherwise, issued or made under this Contract or otherwise issued or made by it, the Engineer, or any officer, agent or employee of the Authority, from showing at any time the true amount and character of Work performed, or from showing that any such acceptance, certificate or payment is incorrect or was improperly issued or made; and the Authority shall not be precluded or estopped, notwithstanding any such acceptance, certificate or payment, from recovering from the Contractor any damages which it may sustain by reason of any failure on his part to comply strictly with this Contract, and any moneys which may be paid to him or for his account in excess of those to which he is lawfully entitled.

Neither the acceptance of the Work or any part thereof, nor any payment therefor, nor any order or certificate issued under this Contract or otherwise issued by the Authority, the Engineer, or any officer, agent or employee of the Authority, nor any permission or direction to continue with the performance of Work, nor any performance by the Authority of any of the Contractor's duties or obligations, nor any aid lent to the Contractor by the Authority in his performance of such duties or obligations, nor any other thing done or omitted to be done by the Authority, its Commissioners , officers, agents or employees shall be deemed to be a waiver of any provision of this Contract or of any rights or remedies to which the Authority may be entitled because of any breach thereof, excepting only a resolution of its Commissioners, providing expressly for such waiver. No cancellation, rescission or annulment hereof, in whole or as to any part of the Work, because of any breach hereof, shall be deemed a waiver of any money damages to which the Authority may be entitled because of such breach. Moreover, no waiver by the Authority of any breach of this Contract shall be deemed to be a waiver of any other or any subsequent breach.

CHAPTER VII

MISCELLANEOUS

73. SUBMISSION TO JURISDICTION

The Contractor hereby irrevocably submits himself to the jurisdiction of the Courts of the State of New York and to the jurisdiction of the Courts of the State of New Jersey in regard to any controversy arising out of, connected with, or in any way concerning the Proposal or this Contract. The Contractor agrees that service of process on the Contractor in relation to such jurisdiction may be made, at the option of the Authority, either by registered or certified mail addressed to the applicable office as provided for in the clause hereof entitled "Service of Notices on the Contractor", by registered or certified mail addressed to any office actually maintained by the Contractor or by actual personal delivery to the Contractor if the Contractor be an individual, to any partner if the Contractor be a partnership or to an officer, director or managing or general agent if the Contractor be a corporation.

Such service shall be deemed to be sufficient when jurisdiction would not lie because of the lack of basis to serve process in the manner otherwise provided by law. In any case, however, process may be served as stated above whether or not it might otherwise have been served in a different manner.

74. PROVISIONS OF LAW DEEMED INSERTED

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included therein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

75. INVALID CLAUSES

If any provision of this Contract shall be such as to destroy its mutuality or to render it invalid or illegal, then, if it shall not appear to have been so material that without it the Contract would not have been made by the parties, it shall not be deemed to form part thereof but the balance of the Contract shall remain in full force and effect.

76. NON-LIABILITY OF THE AUTHORITY REPRESENTATIVES

Neither the Commissioners of the Authority nor any officer, agent, or employee thereof shall be charged personally by the Contractor with any liability or held liable to him under any term or provision of this Contract, or because of its execution or attempted execution, or because of any breach hereof.

77. SERVICE OF NOTICES ON THE CONTRACTOR

Whenever provision is made in this Contract for the giving of any notice to the Contractor, its deposit in any post office or post office box, enclosed in a postpaid wrapper addressed to the Contractor at his office, or its delivery to his office, shall be sufficient service thereof as of the date of such deposit or delivery, except to the extent, if any, otherwise provided in the clause entitled "Submission to Jurisdiction". Until further notice to the Authority the Contractor's office will be that stated in his Proposal. Notices may also be served personally upon the Contractor; or if a corporation, upon any officer, director, or managing or general agent; or if a partnership upon any partner.

78. MODIFICATION OF CONTRACT

No change in or modification, termination or discharge of this Contract, in any form whatsoever, shall be valid or enforceable unless it is in writing and signed by the party to be charged therewith or his duly authorized representative, provided, however, that any change in or modification, termination or discharge of this Contract expressly provided for in this Contract shall be effective as so provided.

The authority of any person to order Extra Work or to alter the Contract Drawings and Specifications does not include the power to cancel, modify or waive any provision of the Form of Contract, and no officer or other representative of the Authority shall have the power so to do unless and until hereafter so authorized by or pursuant to a resolution of the Commissioners of the Authority or by or pursuant to a resolution of their appropriate Committee.

79. *PUBLIC RELEASE OF INFORMATION*

The Contractor and all his subcontractors shall not issue or permit to be issued any press release, advertisement, or literature of any kind, which refers to the Authority or the services performed in connection with this Contract, without first obtaining the written approval of the Chief Engineer. Such approval may be withheld if for any reason the Chief Engineer believes that the publication of such information would be harmful to the public interest or is in any way undesirable. This provision shall survive termination or expiration of this Contract.

PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS that we, the undersigned[30] Contractor and surety company (or companies), as principal and surety (or sureties), respectively,

Contractor	Surety

30 Insert names of the Contractor and surety company (or companies) in the appropriate columns. If space is insufficient add rider.

If the Contractor is a corporation, give the state of incorporation, using also the phrase "a corporation organized under the laws of _____".

If the Contractor is a partnership, give full names of partners, using the phrase "co-partners doing business under the firm name of _____".

If the Contractor is an individual using a trade name, give individual name, using also the phrase "an individual doing business under the trade name of _____.".

are hereby held and firmly bound unto The Port Authority of New York and New Jersey (herein called the "Authority") in the penal sum of _____ Dollars

and _____ Cents ($ _____.), for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, representatives, executors, administrators, successors and assigns. Each surety, however, if there is more than one, shall be jointly and severally liable for said penal sum.

Signed this _____ day of _____ 20

The condition of the above obligation is that

WHEREAS, the above named principal has entered into a Contract in writing with the Authority, a copy of which is hereby made a part of this bond as though herein set forth in full and which is designated Contract AKB-264.039 - "Bayonne Bridge - Bayonne Bridge - Replacement of Main Span Roadway and Approach Structures", and

WHEREAS, the Authority has required this bond for the faithful performance of all obligations imposed by said Contract and also for the payment of all lawful claims of subcontractors, materialmen and workmen arising out of the performance of said Contract;

NOW, if the said principal shall well and faithfully do and perform the things agreed by him to be done and performed according to the terms and true intent and meaning of said Contract and if all lawful claims of subcontractors, materialmen and workmen arising out of the performance of said Contract are paid, then this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that, provided the sureties shall comply with the provisions hereof, the aggregate liability of all sureties for any and all claims hereunder shall in no event exceed the penal amount of this obligation as hereinbefore stated.

This undertaking is for the benefit of the Authority and all subcontractors, materialmen and workmen having lawful claims arising out of the performance of said Contract, and all such subcontractors, materialmen and workmen (as well as the Authority itself) shall have a direct right of action upon this bond; but the rights and equities of such subcontractors, materialmen and workmen shall be subject and subordinate to those of the Authority.

The sureties, for value received, hereby stipulate and agree that the obligations of said sureties and their bond shall be in no way impaired or affected by any extensions of time, modification, omission, addition or change in or to the said Contract or the construction to be performed thereunder, or by any supervision or inspection or omission to supervise or inspect the construction, or by any payment thereunder before the time required therein, or by any waiver of any provision or condition thereof (whether precedent or subsequent), or by any assignment, subletting or other transfer thereof or of any part thereof or of any construction to be performed or any moneys due or to become due thereunder; and said sureties do hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers, and hereby expressly stipulate and agree that any and all things done and omitted to be done by and in relation to assignees, subcontractors and other transferees shall have the same effect as to said sureties as though done by or in relation to said principal.

The sureties shall give the General Counsel of the Authority the following notices:

A. Written notice of an intent to pay any claim of a subcontractor, materialman or workman hereunder;

B. Written notice within five days of the institution of an action by a subcontractor, materialman or workman hereunder.

The sureties shall not pay the claim of any subcontractor, materialman or workman hereunder until the expiration of thirty days after receipt by said General Counsel of notice under either subparagraph A or B above, describing the claim to be paid.

IN WITNESS WHEREOF, the principal and the sureties have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____

Principal

(Seal) By [31] _____

_____

Surety

By[32] _____

APPROVED AS TO ACCEPTABILITY OF SURETIES:

_____

Credit Manager

_____ 20

---

31 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

32 Add signatures of additional sureties, if any.

ACKNOWLEDGMENT OF PRINCIPAL, IF A CORPORATION

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known, who being by me duly sworn, did depose and say that he resides at _____; that he is the _____. of _____ the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation, and that he signed his name thereto by like order.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF PRINCIPAL, IF A PARTNERSHIP

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me

personally came and appeared _____, to me known, and known to me to be one of the members of the firm of _____ _____ described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF PRINCIPAL, IF AN INDIVIDUAL

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal) _____

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

SPECIFICATIONS

DIVISION 1

GENERAL PROVISIONS

80. CONSTRUCTION REQUIRED BY THE SPECIFICATIONS

These Specifications relate generally to performing raising the roadway of the Bayonne Bridge by replacing the bridge's elements except the main span arch and arch abutments, constructing new approaches and toll collection and traffic control systems, constructing new administration and Resident Engineer's office, mechanical/electrical buildings, storage building and related work at the construction site.

These Specifications require the doing of all things necessary or proper for or incidental to the matter referred to in the immediately preceding paragraph, as shown on the Contract Drawings in their present form. In addition, all things shown on the Contract Drawings even though not expressly mentioned in these Specifications, all things mentioned in these Specifications even though not shown on the Contract Drawings, and all things not specified either on the Contract Drawings, or in the Specifications but involved in carrying out their intent and in the complete and proper execution of the matter referred to in the immediately preceding paragraph are required by these Specifications; and the Contractor shall perform the same as though they were specifically delineated, described and mentioned.

In case of a conflict between a requirement of the Contract Drawings and a requirement in Division 1 of the Specifications, the requirement of Division 1 shall control. In case of a conflict between a requirement contained in other Divisions of the Specifications and a requirement of the Contract Drawings, the requirement of the Contract Drawings shall control.

Some Sections of the Specifications make cross references to construction specified in other Sections of the Specifications, including cross references intended to avoid duplication by the bidders in quoting prices and to point out some of the necessity for coordination. Such cross references are not intended to be complete or all inclusive, and the Contractor shall ascertain for himself both the nature and the extent of all construction which may be related to that under each Section of the Specifications whether or not expressly referred to.

Some Sections of the Specifications contain a general description of the construction under such Sections. Such description is merely a very general one and is not intended to outline the construction required by the Specifications and Contract Drawings. Accordingly, such description shall be construed as in aid of and supplemental to, but in no case limiting, impairing or decreasing, the requirements elsewhere set forth with respect to the construction to be performed.

The Contractor's compensation for all construction whatsoever referred to in the Specifications and Contract Drawings in their present form, even though the need for certain items of such construction may be contingent upon future occurrences or determinations or upon other circumstances, shall be deemed to be included in the price(s) quoted by the Contractor in the Form of Contract unless the Specifications or Contract Drawings expressly state that compensation in addition to such price shall be payable for such items of construction. The express statement in some cases to the effect that certain construction shall be without additional cost to the Authority shall not impair the application of this paragraph in other cases.

The distribution of various parts of the construction among the Divisions and Sections of the Specifications or among the Contract Drawings is not intended as a representation of the most effective or logical method of organizing, scheduling, or subcontracting the construction, and the Contractor shall ascertain for himself how to do so unless otherwise expressly prescribed in this Contract.

In all cases the provisions of the second paragraph of this numbered Section shall control.

81. AVAILABLE PROPERTY

Subject to the conditions elsewhere stated herein, those areas to be occupied by the permanent construction will be made available to the Contractor upon the commencement of his first operations at the construction site, together with an area shown on Contract Drawing No. CS0001 and designated "Area Available For Contractor's Use".

Any additional property which the Contractor desires for his operations shall be obtained by him at his own expense.

The following restrictions apply:

A. No work on site may commence earlier than May 25, 2013, or as directed by the Engineer.

B. No tree removals work shall commence earlier than July 1, 2013, or as directed by the Engineer.

C. No soil/earthwork disturbance activity may commence in New Jersey earlier than July 1, 2013, or as directed by the Engineer.

D. No New York City Street lane or sidewalk related work may commence earlier than July 31, 2013, or as directed by the Engineer.

E. Reference is made to the area identified as Baseball Fields on Drawing C0307. This area is bounded by West First Street on the north, existing fencing under the bridge to the west, asphalt parking lots to the east, and existing fence to be removed to the south. No work within this area, nor any removals around its perimeter shall commence until July 1, 2013 or as directed by the Engineer.

The Contractor will be permitted to use only so much of the aforesaid areas as is necessary for the performance of the Contract, and he must at all times so conduct his operations as not to encroach upon or block the portions used by others. The Engineer may at any time make joint or exclusive assignments of particular portions thereof, either to the Contractor or to others, and may take over and use for other purposes any portions which, in the opinion of Engineer, are not required for the performance of the Contract.

The Contractor shall daily clean up the areas made available to him so that they are free at all times of refuse, rubbish, scrap material or debris.

82. CONSTRUCTION SITE SECURITY REQUIREMENTS

The Port Authority of New York and New Jersey operates facilities and systems at which terrorism or other criminal acts may have a significant impact on life safety and key infrastructures. The Authority reserves the right to impose multiple layers of security requirements on the performance of the Work of the Contract, including on the Contractor, subcontractors and materialmen, depending upon the level of security required, as determined by the Authority. The Contractor shall comply, and shall ensure that his subcontractors and materialmen comply, with the following security requirements:

A. Identity Checks, Background Screening and Issuance of Photo Identification Cards

No person will be permitted on or about the construction site without a Facility Photo ID issued by the Authority or without an escort designated by the Authority. Facility Photo IDs are required for employees of the Contractor, subcontractors and materialmen. All employees of the Contractor, subcontractors and materialmen shall wear Facility Photo IDs in a conspicuous and clearly visible position whenever they are working at the construction site.

As part of the requirement for the issuance of Facility IDs, the Contractor shall perform background checks through the Secure Worker Access Consortium (SWAC) and obtain SWAC ID cards with a "HIGH" SWAC approval level for all workmen and materialmen on this Contract. Information on the SWAC process, including office locations and hours of operation, is available on the following website: http://www.secureworker.com/ .

The Contractor shall coordinate with the Engineer to obtain Facility Photo IDs. The SWAC ID card, a state issued driver's license and an additional form of identification shall be presented by each workman and materialman in order to be issued a Facility Photo ID by the Authority. Facility Photo IDs will be issued at no cost to the Contractor.

The Contractor shall ensure that all workmen and materialmen renew their SWAC ID and Facility Photo ID prior to the respective ID cards' expiration dates. Any workman or materialman with an expired SWAC ID or expired Facility Photo ID shall not be permitted access to the construction site.

At the discretion of the Facility Manager or the Authority designee, the Facility Manager may assign Escort designation for approved Contractor designated staff, to permit supervised access for visitors, delivery personnel and temporary support staff (i.e., utility workers, equipment repairman, etc). The Escort must be physically present and maintain visual contact with an escorted individual at all times. The Contractor will be provided 'Visitor Badges' by the Agency to be furnished to the escorted individuals. Each escorted individual shall furnish their name, address, birth date (from a government ID), along with their company affiliation in order to be provided a visitor badge. The Contractor shall maintain a listing of all visitors, the information furnished (sentence above) and the badges number issued and submit a monthly report of Visitor Badge usage. The specific form of the Visitor Badge Utilization Report is subject to the approval of the General Manager. This will permit temporary subcontractors, suppliers and other personnel, limited site access without having to go through the SWAC process. Any Contractor, subcontractor or other personnel required to be on the site for more than Five days must obtain a Facility ID.

B. Construction Site Access Control:

1.) The Authority will provide for construction site access control, inspection and monitoring by Authority retained security guards. However, this provision shall not relieve the Contractor of his responsibility to secure equipment and Work at the construction site at his own expense.

2.) At the beginning of each work period or work shift, the Contractor shall furnish to the Engineer a memorandum showing for that work period or work shift:

a. The name and company affiliation of each employee of the Contractor or of a subcontractor who is expected to enter the construction site and,

b. The name of each firm expected to deliver materials, service equipment or perform other services and a description of such materials or services.

C. Contractors Security Officer:

1) *The Contractor shall identify and designate a Security Officer and submit the name* and resume to the Construction Manager for approval. The Contractor's designee shall have a minimum of five (5) years experience as a construction security officer on a minimum of two (2) construction projects. The Contractor's Security Officer shall be subjected to a background check coordinated by the Authority, and shall be required to successfully and fully pass the background check before being considered for approval.

2) The Contractor's Security Officer may have other responsibilities as determined by the Contractor, so long as it does not interfere with or provide insufficient time or resources to carry out the required mandates set forth under this entire section.

3) The Contractor's Security Officer shall be responsible for security activities and act as the Contractor's primary coordinator/liaison for all security related matters.

4) The Contractor's Security Officer's duties and responsibilities shall include, but are not limited to the following:

a. Development, implementation and maintenance of the Contractors' construction security procedures.

b. Liaise between the Contractor, Engineer and first responders in emergency situations and other internal and external organizations on security matters.

c. Respond to emergencies and implement appropriate responses.

d. Provide reports on visitor and escort activities.

5) The Contractor's Security Officer shall participate in site security planning efforts and implement appropriate action.

6) The Contractor's Security Officer shall meet with the Engineer on a monthly basis at a minimum, or when deemed necessary by the Engineer.

D. High Security Areas:

1.) If Work under this Contract is required in high security areas, as may be designated as such by the Authority, the Contractor shall comply with certain security procedures while performing Work in such areas. The security procedures may require that the Contractor, subcontractors or materialmen performing Work in such areas be escorted to and from these areas by security personnel designated by the Authority. Further, the Contractor, subcontractors or materialmen may be required to be monitored by security personnel designated by the Authority while performing Work in certain high security areas.

2.) Prior to the start of Work at the construction site, the Contractor will be provided with a description of the high security areas from the Authority, which will be in effect on the date that Work commences. The description of high security areas may be changed at any time by the Authority during the duration of this Contract. The Contractor shall notify the Authority no less than twenty-four hours prior to the performance of any Work in a high security area. The Contractor shall conform to the security procedures as may be established by the Authority and the escorting and monitoring of workmen and materialmen hereunder.

The Authority may impose, increase, and/or upgrade security requirements for the Contractor, subcontractors and materialmen during the duration of this Contract to address changing security conditions and/or new governmental regulations. The Contractor will be compensated for changes to the security requirements as directed by the Engineer at the Net Cost of such Work. "Net Cost" shall be computed in the same manner as is compensation for extra work, including any percentage addition to cost, as set forth in the clause of the Form of Contract entitled "Compensation for Extra Work". Performance of such Net Cost Work shall be as directed by the Engineer and shall be subject to all provisions of the Contract relating to performance of extra work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for extra work.

83. MATERIALS FURNISHED BY THE AUTHORITY

A. The Authority will furnish the following materials as specified on Drawing ES0104 to be installed by the Contractor.

1.) FIREWALL – Cisco ASA 5500

2.) IE3010 – 16-PORT RUGGED ETHERNET SWITCH

3.) MOD – 1000MBPS SFP SINGLE MODE RUGGED 1-Port SFP (mini GBIC)

4.) PS – LOW DC POWER SUPPLY FOR IE 301

B. The Authority will furnish and install the following materials and services as specified on Drawing ES0104:

1.) SERVERS (HARDWARES)

2.) STORAGE SERVERS/DEVICES

3.) VERIZON LEASED RACK

4.) EPL ROUTER

5.) CATALYST 3750-X-24 SWITCH

6.) CATALYST 3750-X-24 SWITCH WITH PoE

7.) RACK MOUNTED LAPTOP

8.) RUGGEDIZED MAINTENANCE LAPTOP

9.) KVM SWITCH

10.) WORKSTATION MONITOR

11.) OPTICAL MOUSE

Materials furnished by the Authority to the Contractor shall be examined by him at the time they are furnished to him, and if there is any shortage, damage or other defect, the Contractor shall at that time bring it specifically in writing to the attention of the Engineer. Any shortage, damage or defect so brought to the Engineer's attention and acknowledged by him will be corrected by the Authority. If no shortage, damage or other defect is so brought to the attention of and acknowledged by the Engineer at the time said materials are furnished to the Contractor, the materials shall thereafter conclusively be deemed to have been satisfactory in all respects, provided that if the Contractor demonstrates to the satisfaction of the Engineer that there was a shortage, damage or defect at the time the materials were furnished to the Contractor and that such fact could not reasonably have been ascertained at that time, then the shortage, damage or defect will be corrected by the Authority.

From the date the foregoing materials are furnished to the Contractor they shall form part of the materials included in the risks assumed by the Contractor as provided in subparagraph A of the clause of the Form of Contract entitled "Risks Assumed by the Contractor".

All materials or portions thereof in excess of those actually required in the permanent construction and which in the opinion of the Engineer may be suitable for use by the Authority shall be returned to the Authority at a location at the construction site designated by the Engineer upon the completion of the Work or when there is no longer any need for this material, whichever may first occur.

The Contractor at his own expense shall furnish all materials and services required by the Contract Drawings and Specifications with the exception of those materials and services expressly provided to be furnished to the Contractor by the Authority in accordance with this numbered Section.

The foregoing materials shall be delivered to the construction site by the Contractor, who shall load and transport them to the point of installation.

84. OPERATIONS OF OTHERS

During the time that the Contractor is performing the Contract, other persons will be engaged in other operations on or about the construction site including normal facility operations and maintenance, other Authority contracts and vehicular and pedestrian access, all of which shall remain uninterrupted.
The Contractor shall so plan and conduct his operations as to work in harmony with others engaged at the construction site and not to delay, endanger or interfere with the operations of others (whether or not specifically mentioned above), all to the best interests of the Authority and the public and as may be directed by the Engineer.

85. LABOR ACTIONS

Whenever any labor strike, slowdown, work stoppage, picketing or other labor action which might interfere with the performance of the Contract, or of other Authority or PATH contracts or the operation of any Authority or PATH facility occurs at the construction site or at any other Authority or PATH facility as a result of the Contractor's (or its subcontractor's) utilization of particular means, methods or manpower to perform the Work required by the Contract, the Contractor shall pursue all remedies which are appropriate and available to him to avoid such interference.

86. CONTRACTOR'S MEETINGS

The Contractor shall conduct job progress and coordination meetings with subcontractors in his field office every two weeks, or as frequently as job conditions require or the Engineer may request. The Engineer shall be notified and, at his option, may attend these meetings. The Contractor shall prepare and distribute minutes to the Engineer and the subcontractors within forty-eight (48) hours of the day following the meetings.

The Contractor shall attend separate job progress and coordination meetings with the Engineer every two weeks, or at times otherwise requested by the Engineer.

87. CONTRACT DRAWINGS

The Contract Drawings which accompany and form a part of these Specifications bear the general title "*The Port Authority of NY & NJ - Bayonne Bridge - Bayonne Bridge - Replacement of Main Span* Roadway and Approach Structures - Contract AKB-264.039" and are separately numbered and entitled as follows:

DWG. NO.	TITLE	DISCIPLINE
G0101	TITLE SHEET	GENERAL
G0102	INDEX OF DRAWINGS - SHEET 1	GENERAL
G0103	INDEX OF DRAWINGS - SHEET 2	GENERAL
G0104	INDEX OF DRAWINGS - SHEET 3	GENERAL
G0105	INDEX OF DRAWINGS - SHEET 4	GENERAL
G0106	INDEX OF DRAWINGS - SHEET 5	GENERAL
G0107	INDEX OF DRAWINGS - SHEET 6	GENERAL
G0108	INDEX OF DRAWINGS - SHEET 7	GENERAL
G0109	INDEX OF DRAWINGS - SHEET 8	GENERAL
G0110	INDEX OF DRAWINGS - SHEET 9	GENERAL
G0111	INDEX OF DRAWINGS - SHEET 10	GENERAL
G0112	INDEX OF DRAWINGS - SHEET 11	GENERAL
G0201	LEGENDS AND ABBREVIATIONS	GENERAL
G0202	GENERAL NOTES - SHEET 1	GENERAL
G0203	GENERAL NOTES - SHEET 2	GENERAL
G0204	GENERAL NOTES - SHEET 3	GENERAL
G0205	KEY PLAN AND ELEVATION - EXISTING STRUCTURE	GENERAL
G0206	KEY PLAN AND ELEVATION - PROJECT SITE PLAN	GENERAL

C0101	CIVIL LEGEND	CIVIL
C0102	CIVIL ABBREVIATIONS	CIVIL
C0103	CIVIL NOTES	CIVIL
C0104	KEY PLAN - SHEET 1	CIVIL
C0105	KEY PLAN - SHEET 2	CIVIL
C0106	PROJECT LIMIT PLAN - SHEET 1	CIVIL
C0107	PROJECT LIMIT PLAN - SHEET 2	CIVIL
C0108	SURVEY CONTROL PLAN - SHEET 1	CIVIL
C0109	SURVEY CONTROL PLAN - SHEET 2	CIVIL
C0110	SURVEY CONTROL PLAN - SHEET 3	CIVIL
C0111	LIMIT OF WORK PLAN - SHEET 1	CIVIL
C0112	LIMIT OF WORK PLAN - SHEET 2	CIVIL
C0113	LIMIT OF WORK PLAN - SHEET 3	CIVIL
C0114	LIMIT OF WORK PLAN - SHEET 4	CIVIL
C0115	LIMIT OF WORK PLAN - SHEET 5	CIVIL
C0116	LIMIT OF WORK PLAN - SHEET 6	CIVIL
C0201	TYPICAL SECTIONS - SHEET 1	CIVIL
C0202	TYPICAL SECTIONS - SHEET 2	CIVIL
C0203	TYPICAL SECTIONS - SHEET 3	CIVIL
C0204	TYPICAL SECTIONS - SHEET 4	CIVIL
C0205	TYPICAL SECTIONS - SHEET 5	CIVIL
C0206	TYPICAL SECTIONS - SHEET 6	CIVIL
C0207	TYPICAL SECTIONS - SHEET 7	CIVIL
C0208	TYPICAL SECTIONS - SHEET 8	CIVIL
C0209	TYPICAL SECTIONS - SHEET 9	CIVIL
C0210	TYPICAL SECTIONS - SHEET 10	CIVIL
C0211	TYPICAL SECTIONS - SHEET 11	CIVIL
C0212	TYPICAL SECTIONS - SHEET 12	CIVIL
C0213	TYPICAL SECTIONS - SHEET 13	CIVIL
C0214	CROSS SECTIONS TEMPORARY - SHEET 1	CIVIL
C0215	CROSS SECTIONS TEMPORARY - SHEET 2	CIVIL
C0301	REMOVAL PLAN - SHEET 1	CIVIL
C0302	REMOVAL PLAN - SHEET 2	CIVIL
C0303	REMOVAL PLAN - SHEET 3	CIVIL
C0304	REMOVAL PLAN - SHEET 4	CIVIL
C0305	REMOVAL PLAN - SHEET 5	CIVIL
C0306	REMOVAL PLAN - SHEET 6	CIVIL
C0307	REMOVAL PLAN - SHEET 7	CIVIL
C0308	REMOVAL PLAN - SHEET 8	CIVIL
C0309	REMOVAL PLAN - SHEET 9	CIVIL
C0310	REMOVAL PLAN - SHEET 10	CIVIL

C0311	REMOVAL PLAN - SHEET 11	CIVIL
C0312	REMOVAL PLAN - SHEET 12	CIVIL
C0313	REMOVAL PLAN - SHEET 13	CIVIL
C0401	HORIZONTAL ALIGNMENT DATA - SHEET 1	CIVIL
C0402	HORIZONTAL ALIGNMENT DATA - SHEET 2	CIVIL
C0403	HORIZONTAL ALIGNMENT DATA - SHEET 3	CIVIL
C0404	HORIZONTAL ALIGNMENT DATA - SHEET 4	CIVIL
C0405	ALIGNMENT PLAN - SHEET 1	CIVIL
C0406	ALIGNMENT PLAN - SHEET 2	CIVIL
C0407	ALIGNMENT PLAN - SHEET 3	CIVIL
C0408	ALIGNMENT PLAN - SHEET 4	CIVIL
C0409	ALIGNMENT PLAN - SHEET 5	CIVIL
C0410	ALIGNMENT PLAN - SHEET 6	CIVIL
C0411	ALIGNMENT PLAN - SHEET 7	CIVIL
C0412	ALIGNMENT PLAN - SHEET 8	CIVIL
C0413	ALIGNMENT PLAN - SHEET 9	CIVIL
C0414	ALIGNMENT PLAN - SHEET 10	CIVIL
C0415	ALIGNMENT PLAN - SHEET 11	CIVIL
C0416	ALIGNMENT PLAN - SHEET 12	CIVIL
C0417	ALIGNMENT PLAN - SHEET 13	CIVIL
C0418	PROFILE - SHEET 1	CIVIL
C0419	PROFILE - SHEET 2	CIVIL
C0420	PROFILE - SHEET 3	CIVIL
C0421	PROFILE - SHEET 4	CIVIL
C0422	PROFILE - SHEET 5	CIVIL
C0423	PROFILE - SHEET 6	CIVIL
C0424	PROFILE - SHEET 7	CIVIL
C0425	PROFILE - SHEET 8	CIVIL
C0426	PROFILE - SHEET 9	CIVIL
C0427	PROFILE - SHEET 10	CIVIL
C0428	PROFILE - SHEET 11	CIVIL
C0429	PROFILE - SHEET 12	CIVIL
C0430	PROFILE - SHEET 13	CIVIL
C0431	PROFILE - SHEET 14	CIVIL
C0432	PROFILE - SHEET 15	CIVIL
C0433	PROFILE - SHEET 16	CIVIL
C0434	PROFILE - SHEET 17	CIVIL
C0435	PROFILE - SHEET 18	CIVIL
C0436	PROFILE - SHEET 19	CIVIL
C0437	PROFILE - SHEET 20	CIVIL
C0438	PROFILE - SHEET 21	CIVIL

C0439	PROFILE - SHEET 22	CIVIL
C0440	PROFILE - SHEET 23	CIVIL
C0441	PROFILE - SHEET 24	CIVIL
C0442	PROFILE - SHEET 25	CIVIL
C0443	PROFILE - SHEET 26	CIVIL
C0444	PROFILE - SHEET 27	CIVIL
C0445	PROFILE - SHEET 28	CIVIL
C0460	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 2 - SHEET 1	CIVIL
C0461	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 2 - SHEET 2	CIVIL
C0462	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 3 - SHEET 3	CIVIL
C0463	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 4 - SHEET 4	CIVIL
C0464	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 4 - SHEET 5	CIVIL
C0465	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 4 - SHEET 6	CIVIL
C0466	TEMPORARY DETOUR ALIGNMENT PLAN STAGE 4 - SHEET 7	CIVIL
C0467	MAINTENANCE OF TRAFFIC TEMPORARY DETOUR PROFILE - SHEET 1	CIVIL
C0468	MAINTENANCE OF TRAFFIC TEMPORARY DETOUR PROFILE - SHEET 2	CIVIL
C0469	MAINTENANCE OF TRAFFIC TEMPORARY DETOUR PROFILE - SHEET 3	CIVIL
C0470	MAINTENANCE OF TRAFFIC TEMPORARY DETOUR PROFILE - SHEET 4	CIVIL
C0501	PAVING PLAN - SHEET 1	CIVIL
C0502	PAVING PLAN - SHEET 2	CIVIL
C0503	PAVING PLAN - SHEET 3	CIVIL
C0504	PAVING PLAN - SHEET 4	CIVIL
C0505	PAVING PLAN - SHEET 5	CIVIL
C0506	PAVING PLAN - SHEET 6	CIVIL
C0507	PAVING PLAN - SHEET 7	CIVIL
C0508	PAVING PLAN - SHEET 8	CIVIL
C0509	PAVING PLAN - SHEET 9	CIVIL
C0510	PAVING PLAN - SHEET 10	CIVIL
C0511	PAVING PLAN - SHEET 11	CIVIL
C0512	PAVING PLAN - SHEET 12	CIVIL
C0513	PAVING PLAN - SHEET 13	CIVIL
C0601	GRADING PLAN - SHEET 1	CIVIL

C0602	GRADING PLAN - SHEET 2	CIVIL
C0603	GRADING PLAN - SHEET 3	CIVIL
C0604	GRADING PLAN - SHEET 4	CIVIL
C0605	GRADING PLAN - SHEET 5	CIVIL
C0606	GRADING PLAN - SHEET 6	CIVIL
C0607	GRADING PLAN - SHEET 7	CIVIL
C0608	GRADING PLAN - SHEET 8	CIVIL
C0609	GRADING PLAN - SHEET 9	CIVIL
C0610	GRADING PLAN - SHEET 10	CIVIL
C0611	GRADING PLAN - SHEET 11	CIVIL
C0612	GRADING PLAN - SHEET 12	CIVIL
C0613	GRADING PLAN - SHEET 13	CIVIL
C0701	DRAINAGE PLAN - SHEET 1	CIVIL
C0702	DRAINAGE PLAN - SHEET 2	CIVIL
C0703	DRAINAGE PLAN - SHEET 3	CIVIL
C0704	DRAINAGE PLAN - SHEET 4	CIVIL
C0705	DRAINAGE PLAN - SHEET 5	CIVIL
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C0711	DRAINAGE PLAN - SHEET 11	CIVIL
C0712	DRAINAGE PLAN - SHEET 12	CIVIL
C0713	DRAINAGE PLAN - SHEET 13	CIVIL
C0714	UTILITY PLAN AND PROFILE - SHEET 1	CIVIL
C0715	UTILITY PLAN AND PROFILE - SHEET 2	CIVIL
C0716	UTILITY PLAN AND PROFILE - SHEET 3	CIVIL
C0717	UTILITY PLAN AND PROFILE - SHEET 4	CIVIL
C0718	UTILITY PLAN AND PROFILE - SHEET 5	CIVIL
C0719	UTILITY PLAN AND PROFILE - SHEET 6	CIVIL
C0720	STORMWATER MANAGEMENT PLAN- SHEET 1	CIVIL
C0721	STORMWATER MANAGEMENT PLAN- SHEET 2	CIVIL
C0722	STORMWATER MANAGEMENT PLAN- SHEET 3	CIVIL
C0723	STORMWATER MANAGEMENT PLAN- SHEET 4	CIVIL
C0724	STORMWATER MANAGEMENT PLAN- SHEET 5	CIVIL
C0725	STORMWATER MANAGEMENT PLAN- SHEET 6	CIVIL
C0726	TEMPORARY DRAINAGE PLAN - SHEET 1	CIVIL
C0727	TEMPORARY DRAINAGE PLAN - SHEET 2	CIVIL
C0728	TEMPORARY DRAINAGE PLAN - SHEET 3	CIVIL
C0729	TEMPORARY DRAINAGE PLAN - SHEET 4	CIVIL

C0730	TEMPORARY DRAINAGE PLAN - SHEET 5	CIVIL
C0731	DRAINAGE PROFILES - SHEET 1	CIVIL
C0732	DRAINAGE PROFILES - SHEET 2	CIVIL
C0733	DRAINAGE PROFILES - SHEET 3	CIVIL
C0734	DRAINAGE PROFILES - SHEET 4	CIVIL
C0735	DRAINAGE PROFILES - SHEET 5	CIVIL
C0801	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 1	CIVIL
C0802	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 2	CIVIL
C0803	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 3	CIVIL
C0804	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 4	CIVIL
C0805	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 5	CIVIL
C0806	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 6	CIVIL
C0807	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 7	CIVIL
C0808	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 8	CIVIL
C0809	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 9	CIVIL
C0810	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 10	CIVIL
C0811	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 11	CIVIL
C0812	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 12	CIVIL
C0813	SOIL EROSION AND SEDIMENT CONTROL PLAN - SHEET 13	CIVIL
C0901	PAVEMENT DETAILS	CIVIL
C0902	CURB DETAILS	CIVIL
C0903	SIDEWALK AND DRIVEWAY DETAILS	CIVIL
C0904	CURB RAMP AND SIDEWALK DETAILS	CIVIL
C0905	CURB RAMP DETAILS	CIVIL
C0906	HOT MIX ASPHALT OVERLAY SPLICE (PAVEMENT TERMINATION DETAIL)	CIVIL
C0907	TYPICAL PLAN, CROSS SECTION AND JOINT LAYOUT	CIVIL
C0908	LONGITUDINAL JOINTS	CIVIL
C0909	LONGITUDINAL JOINT TIES	CIVIL
C0910	LONGITUDINAL JOINT SAWING AND SEALING	CIVIL

C0911	TRANSVERSE JOINTS	CIVIL
C0912	TRANSVERSE JOINT SAWING AND SEALING	CIVIL
C0913	UTILITY ISOLATION AND JOINT LAYOUT GENERAL NOTES	CIVIL
C0914	UTILITY ISOLATION GUIDELINES	CIVIL
C0915	TELESCOPING MANHOLE CASTING LAYOUT	CIVIL
C0916	NON-TELESCOPING MANHOLE CASTING LAYOUT	CIVIL
C0917	SHALLOW STRUCTURE ISOLATION	CIVIL
C0918	DRAINAGE STRUCTURE ISOLATION	CIVIL
C0919	DRAINAGE STRUCTURE ISOLATION NEAR MANHOLE CASTINGS	CIVIL
C0920	MULTIPLE UTILITIES ISOLATION	CIVIL
C0921	TRANSITION AND RESTORATION DETAILS	CIVIL
C0922	EARTHWORK TRANSITION DETAILS	CIVIL
C0923	SUBDRAIN DETAILS	CIVIL
C0924	CHAIN LINK FENCE AND GATE LEAF DETAILS	CIVIL
C0925	ROLLING GATE DETAILS	CIVIL
C0926	SURVEY MARKER DETAILS	CIVIL
C0927	TREE TRIMMING AND PROTECTION DETAILS	CIVIL
C0928	ACCESS FROM INNIS STREET GRADING PLAN	CIVIL
C0929	ACCESS FROM INNIS STREET PROFILE	CIVIL
C0930	NJ RESIDENT ENGINEER OFFICE SITE DETAIL	CIVIL
C0931	NY RESTORATION DETAILS - SHEET 1	CIVIL
C0932	NY RESTORATION DETAILS - SHEET 2	CIVIL
C0933	NJ RESTORATION DETAILS - SHEET 1	CIVIL
C0934	NJ RESTORATION DETAILS - SHEET 2	CIVIL
C0935	NJ RESIDENT ENGINEER OFFICE – UTILITIES	CIVIL
C1001	SEWER DETAILS - SHEET 1	CIVIL
C1002	SEWER DETAILS - SHEET 2	CIVIL
C1003	SEWER DETAILS - SHEET 3	CIVIL
C1004	SEWER DETAILS - SHEET 4	CIVIL
C1005	SEWER DETAILS - SHEET 5	CIVIL
C1006	SEWER DETAILS - SHEET 6	CIVIL
C1007	SEWER DETAILS - SHEET 7	CIVIL
C1008	SEWER DETAILS - SHEET 8	CIVIL
C1009	STORMWATER MANAGEMENT DETAILS - SHEET 1	CIVIL
C1010	STORMWATER MANAGEMENT DETAILS - SHEET 2	CIVIL
C1011	STORMWATER MANAGEMENT DETAILS - SHEET 3	CIVIL
C1012	STORMWATER MANAGEMENT DETAILS - SHEET 4	CIVIL
C1013	STORMWATER MANAGEMENT DETAILS - SHEET 5	CIVIL
C1014	STORMWATER MANAGEMENT DETAILS - SHEET 6	CIVIL

C1015	STORMWATER MANAGEMENT DETAILS - SHEET 7	CIVIL
C1016	STORMWATER MANAGEMENT DETAILS - SHEET 8	CIVIL
C1017	STORMWATER MANAGEMENT DETAILS - SHEET 9	CIVIL
C1018	STORMWATER MANAGEMENT DETAILS - SHEET 10	CIVIL
C1019	STORMWATER MANAGEMENT DETAILS - SHEET 11	CIVIL
C1020	WATER DETAILS - SHEET 1	CIVIL
C1021	WATER DETAILS - SHEET 2	CIVIL
C1022	WATER DETAILS - SHEET 3	CIVIL
C1023	WATER DETAILS - SHEET 4	CIVIL
C1024	WATER DETAILS - SHEET 5	CIVIL
C1025	WATER DETAILS - SHEET 6	CIVIL
C1101	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 1	CIVIL
C1102	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 2	CIVIL
C1103	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 3	CIVIL
C1104	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 4	CIVIL
C1105	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 5	CIVIL
C1106	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 6	CIVIL
C1107	SOIL EROSION AND SEDIMENT CONTROL DETAILS - SHEET 7	CIVIL
C1201	MISCELLANEOUS TABLES - SHEET 1	CIVIL
C1301	DRAINAGE TABLES - SHEET 1	CIVIL
C1302	DRAINAGE TABLES - SHEET 2	CIVIL
C1303	DRAINAGE TABLES - SHEET 3	CIVIL
C1304	DRAINAGE TABLES - SHEET 4	CIVIL
C1305	SEWER TABLE- SHEET 1	CIVIL
LS0101	LANDSCAPE TREES REMOVAL PLAN - SHEET 1	LANDSCAPE
LS0102	LANDSCAPE TREES REMOVAL PLAN - SHEET 2	LANDSCAPE
LS0103	LANDSCAPE TREES REMOVAL PLAN - SHEET 3	LANDSCAPE
LS0104	LANDSCAPE TREES REMOVAL PLAN - SHEET 4	LANDSCAPE
LS0105	LANDSCAPE TREES REMOVAL PLAN - SHEET 5	LANDSCAPE
LS0106	LANDSCAPE TREES REMOVAL PLAN - SHEET 6	LANDSCAPE
LS0107	LANDSCAPE TREES REMOVAL PLAN - SHEET 7	LANDSCAPE
LS0108	LANDSCAPE TREES REMOVAL PLAN - SHEET 8	LANDSCAPE
LS0109	LANDSCAPE TREES REMOVAL PLAN - SHEET 9	LANDSCAPE
LS0110	LANDSCAPE TREES REMOVAL PLAN - SHEET 10	LANDSCAPE
LS0111	LANDSCAPE TREES REMOVAL PLAN - SHEET 11	LANDSCAPE

LS0112	LANDSCAPE TREES REMOVAL PLAN - SHEET 12	LANDSCAPE
LS0113	LANDSCAPE TREES REMOVAL PLAN - SHEET 13	LANDSCAPE
LS0114	LANDSCAPE TREES REMOVAL PLAN - SHEET 14	LANDSCAPE
LS0115	LANDSCAPE TREES REMOVAL PLAN - SHEET 15	LANDSCAPE
LS0201	LANDSCAPE TREES RESTORATION PLAN - SHEET 1	LANDSCAPE
LS0202	LANDSCAPE TREES RESTORATION PLAN - SHEET 2	LANDSCAPE
LS0203	LANDSCAPE TREES RESTORATION PLAN - SHEET 3	LANDSCAPE
LS0204	LANDSCAPE TREES RESTORATION PLAN - SHEET 4	LANDSCAPE
LS0205	LANDSCAPE TREES RESTORATION PLAN - SHEET 5	LANDSCAPE
LS0206	LANDSCAPE TREES RESTORATION PLAN - SHEET 6	LANDSCAPE
LS0207	LANDSCAPE TREES RESTORATION PLAN - SHEET 7	LANDSCAPE
LS0208	LANDSCAPE TREES RESTORATION PLAN - SHEET 8	LANDSCAPE
LS0209	LANDSCAPE TREES RESTORATION PLAN - SHEET 9	LANDSCAPE
LS0210	LANDSCAPE TREES RESTORATION PLAN - SHEET 10	LANDSCAPE
LS0211	LANDSCAPE TREES RESTORATION PLAN - SHEET 11	LANDSCAPE
LS0212	LANDSCAPE TREES RESTORATION PLAN - SHEET 12	LANDSCAPE
LS0213	LANDSCAPE TREES RESTORATION PLAN - SHEET 13	LANDSCAPE
LS0214	LANDSCAPE TREES RESTORATION PLAN - SHEET 14	LANDSCAPE
LS0215	LANDSCAPE TREES RESTORATION PLAN - SHEET 15	LANDSCAPE
LS0301	LANDSCAPE DETAILS	LANDSCAPE
A0101	GENERAL NOTES, LEGEND, SYMBOLS AND ABBREVIATIONS	ARCHITECTURAL
A0102	BUILDING CODE NOTES	ARCHITECTURAL
A0103	SITE OVERALL PLAN AND ELEVATION	ARCHITECTURAL
A0201	BRIDGE OVERALL PLAN - SHEET 1	ARCHITECTURAL
A0202	BRIDGE OVERALL PLAN - SHEET 2	ARCHITECTURAL
A0203	BRIDGE OVERALL PLAN - SHEET 3	ARCHITECTURAL
A0204	BRIDGE OVERALL PLAN - SHEET 4	ARCHITECTURAL
A0205	BRIDGE OVERALL PLAN - SHEET 5	ARCHITECTURAL
A0206	BRIDGE OVERALL PLAN - SHEET 6	ARCHITECTURAL
A0207	BRIDGE OVERALL PLAN - SHEET 7	ARCHITECTURAL
A0208	BRIDGE OVERALL PLAN - SHEET 8	ARCHITECTURAL
A0211	BRIDGE DETAIL PLAN - SHEET 1	ARCHITECTURAL
A0212	BRIDGE DETAIL PLAN - SHEET 2	ARCHITECTURAL
A0213	BRIDGE DETAIL PLAN - SHEET 3	ARCHITECTURAL
A0214	BRIDGE DETAIL PLAN - SHEET 4	ARCHITECTURAL
A0215	BRIDGE DETAIL PLAN - SHEET 5	ARCHITECTURAL
A0216	BRIDGE DETAIL PLAN - SHEET 6	ARCHITECTURAL
A0401	ADMINISTRATION BUILDING ROOFING REMOVAL PLAN	ARCHITECTURAL
A0402	ADMINISTRATION BUILDING ROOFING	ARCHITECTURAL

	REPLACEMENT PLAN	
A0403	ADMINISTRATION BUILDING ROOF DETAILS - SHEET 1	ARCHITECTURAL
A0404	ADMINISTRATION BUILDING ROOF DETAILS - SHEET 2	ARCHITECTURAL
A0411	NY MECHANICAL/ELECTRICAL BUILDING FLOOR PLAN	ARCHITECTURAL
A0412	NY MECHANICAL/ELECTRICAL BUILDING ROOF PLAN	ARCHITECTURAL
A0413	NY MECHANICAL/ELECTRICAL BUILDING REFLECTED CEILING PLAN	ARCHITECTURAL
A0414	NJ MECHANICAL/ELECTRICAL BUILDING FLOOR PLAN	ARCHITECTURAL
A0415	NJ MECHANICAL/ELECTRICAL BUILDING ROOF PLAN	ARCHITECTURAL
A0416	NJ MECHANICAL/ELECTRICAL BUILDING REFLECTED CEILING PLAN	ARCHITECTURAL
A0417	NY MECHANICAL/ELECTRICAL BUILDING EQUIPMENT PLAN	ARCHITECTURAL
A0418	NY&NJ MECHANICAL/ELECTRICAL BUILDING EXTERIOR ELEVATIONS - SHEET 1	ARCHITECTURAL
A0419	NY&NJ MECHANICAL/ELECTRICAL BUILDING EXTERIOR ELEVATIONS - SHEET 2	ARCHITECTURAL
A0420	NY&NJ MECHANICAL/ELECTRICAL BUILDING BUILDING SECTIONS	ARCHITECTURAL
A0421	NY&NJ MECHANICAL/ELECTRICAL BUILDING WALL SECTIONS - SHEET 1	ARCHITECTURAL
A0422	NY&NJ MECHANICAL/ELECTRICAL BUILDING WALL SECTIONS - SHEET 2	ARCHITECTURAL
A0423	NY&NJ MECHANICAL/ELECTRICAL BUILDING DETAILS - SHEET 1	ARCHITECTURAL
A0424	NY&NJ MECHANICAL/ELECTRICAL BUILDING DETAILS - SHEET 2	ARCHITECTURAL
A0425	NY&NJ MECHANICAL/ELECTRICAL BUILDING DETAILS - SHEET 3	ARCHITECTURAL
A0426	NY&NJ MECHANICAL/ELECTRICAL BUILDING DETAILS - SHEET 4	ARCHITECTURAL
A0431	NY TOWER ELECTRICAL/ELECTRONICS ROOMS LOCATION PLAN / FLOOR PLAN / ROOF PLAN / REFLECTED CEILING PLAN	ARCHITECTURAL
A0432	NJ TOWER ELECTRICAL/ELECTRONICS ROOMS LOCATION PLAN / FLOOR PLAN / ROOF PLAN / REFLECTED CEILING PLAN	ARCHITECTURAL
A0433	NY TOWER ELECTRICAL/ELECTRONICS ROOMS EQUIPMENT PLAN	ARCHITECTURAL

A0434	NY&NJ TOWER ELECTRICAL/ELECTRONICS ROOMS EXTERIOR ELEVATIONS	ARCHITECTURAL
A0435	NY&NJ TOWER ELECTRICAL/ELECTRONICS ROOMS BUILDING SECTIONS / WALL SECTIONS	ARCHITECTURAL
A0436	NY&NJ TOWER ELECTRICAL/ELECTRONICS ROOMS DETAILS - SHEET 1	ARCHITECTURAL
A0437	NY&NJ TOWER ELECTRICAL/ELECTRONICS ROOMS DETAILS - SHEET 2	ARCHITECTURAL
A0441	NY STORAGE BUILDING FLOOR PLAN	ARCHITECTURAL
A0442	NY STORAGE BUILDING ROOF PLAN	ARCHITECTURAL
A0443	NY STORAGE BUILDING REFLECTED CEILING PLAN	ARCHITECTURAL
A0444	NY STORAGE BUILDING EQUIPMENT PLAN	ARCHITECTURAL
A0445	NY STORAGE BUILDING EXTERIOR ELEVATIONS - SHEET 1	ARCHITECTURAL
A0446	NY STORAGE BUILDING EXTERIOR ELEVATIONS - SHEET 2	ARCHITECTURAL
A0447	NY STORAGE BUILDING BUILDING SECTIONS	ARCHITECTURAL
A0448	NY STORAGE BUILDING WALL SECTIONS	ARCHITECTURAL
A0449	NY STORAGE BUILDING DETAILS - SHEET 1	ARCHITECTURAL
A0450	NY STORAGE BUILDING DETAILS - SHEET 2	ARCHITECTURAL
A0451	NY STORAGE BUILDING DETAILS - SHEET 3	ARCHITECTURAL
A0452	NY STORAGE BUILDING ROOF DETAILS	ARCHITECTURAL
A0453	NY STORAGE BUILDING ROOF RAILING DETAILS	ARCHITECTURAL
A0461	NY SALT STORAGE SHED DEMOLITION SITE PLAN / FLOOR PLAN / SECTION	ARCHITECTURAL
A0462	NY SALT STORAGE SHED FLOOR PLANS	ARCHITECTURAL
A0463	NY SALT STORAGE SHED ROOF PLAN	ARCHITECTURAL
A0464	NY SALT STORAGE SHED EXTERIOR ELEVATIONS	ARCHITECTURAL
A0465	NY SALT STORAGE SHED BUILDING SECTIONS	ARCHITECTURAL
A0466	NY SALT STORAGE SHED WALL SECTIONS	ARCHITECTURAL
A0467	NY SALT STORAGE SHED DETAILS - SHEET 1	ARCHITECTURAL
A0468	NY SALT STORAGE SHED DETAILS - SHEET 2	ARCHITECTURAL
A0501	DOOR SCHEDULE	ARCHITECTURAL
A0502	DOOR DETAILS	ARCHITECTURAL
A0503	FINISH SCHEDULE / MATERIAL SCHEDULE	ARCHITECTURAL
A0504	INTERIOR PARTITION TYPES / LOUVER TYPES	ARCHITECTURAL
A0505	BUILDING SIGNAGE	ARCHITECTURAL
A0506	TYPICAL DETAILS	ARCHITECTURAL
A0601	REPRESENTATIVE PLAN OF NJ RESIDENT ENGINEER OFFICE	ARCHITECTURAL
N0101	ENVIRONMENTAL-ASBESTOS ABATEMENT TOLL PLAZA	ENVIRONMENTAL
N0102	ENVIRONMENTAL-ASBESTOS ABATEMENT	ENVIRONMENTAL

	ADMINISTRATION BUILDING ROOF	
N0103	ENVIRONMENTAL-LEAD ABATEMENT TOLL PLAZA	ENVIRONMENTAL
N0104	ENVIRONMENTAL-LEAD ABATEMENT ADMINISTRATION BUILDING ROOF	ENVIRONMENTAL
N0105	ENVIRONMENTAL-LEAD ABATEMENT ADMINISTRATION BUILDING FIRST FLOOR	ENVIRONMENTAL
N0106	ENVIRONMENTAL-LEAD ABATEMENT ADMINISTRATION BUILDING BASEMENT	ENVIRONMENTAL
N0107	ENVIRONMENTAL-LEAD ABATEMENT ABUTMENT BUILDING NEW YORK	ENVIRONMENTAL
N0108	ENVIRONMENTAL-LEAD ABATEMENT ABUTMENT BUILDING NEW JERSEY	ENVIRONMENTAL
G0301	TITLE SHEET	GENERAL
S0101	LEGEND AND ABBREVIATIONS	STRUCTURAL
S0102	STRUCTURAL NOTES - SHEET 1	STRUCTURAL
S0103	STRUCTURAL NOTES - SHEET 2	STRUCTURAL
S0104	STRUCTURAL NOTES - SHEET 3	STRUCTURAL
S0105	GENERAL PLAN AND ELEVATION - SHEET 1	STRUCTURAL
S0106	GENERAL PLAN AND ELEVATION - SHEET 2	STRUCTURAL
S0107	GENERAL PLAN AND ELEVATION - SHEET 3	STRUCTURAL
S0108	GENERAL PLAN AND ELEVATION - SHEET 4	STRUCTURAL
S0109	GENERAL PLAN AND ELEVATION - SHEET 5	STRUCTURAL
S0110	GENERAL PLAN AND ELEVATION - SHEET 6	STRUCTURAL
S0111	GENERAL PLAN AND ELEVATION - SHEET 7	STRUCTURAL
S0112	GENERAL PLAN AND ELEVATION - SHEET 8	STRUCTURAL
S0201	APPROACH SPAN TYPICAL SECTIONS	STRUCTURAL
S0202	TREATMENT OF HORIZONTAL CURVATURE	STRUCTURAL
S0301	FOUNDATION LAYOUT SHEET 1	STRUCTURAL
S0302	FOUNDATION LAYOUT SHEET 2	STRUCTURAL
S0303	FOUNDATION LAYOUT SHEET 3	STRUCTURAL
S0304	FOUNDATION LAYOUT SHEET 4	STRUCTURAL
S0305	DRILLED SHAFT NOTES AND DETAILS SHEET 1	STRUCTURAL
S0306	DRILLED SHAFT NOTES AND DETAILS SHEET 2	STRUCTURAL
S0307	MICRO-PILE NOTES AND DETAILS	STRUCTURAL
S0308	DRILLED SHAFT AND MICRO-PILE LOAD TEST LOCATIONS SHEET 1	STRUCTURAL
S0309	DRILLED SHAFT AND MICRO-PILE LOAD TEST LOCATIONS SHEET 2	STRUCTURAL
S0310	DRILLED SHAFT LOAD TEST NOTES	STRUCTURAL
S0311	MICRO-PILE LOAD TEST NOTES	STRUCTURAL
S0312	DRILLED SHAFT LOAD TEST PLANS AND SECTIONS SHEET 1	STRUCTURAL

S0313	DRILLED SHAFT LOAD TEST PLANS AND SECTIONS SHEET 2	STRUCTURAL
S0314	DRILLED SHAFT LOAD TEST PLANS AND SECTIONS SHEET 3	STRUCTURAL
S0315	DRILLED SHAFT LOAD TEST PLANS AND SECTIONS SHEET 4	STRUCTURAL
S0316	FOOTING PLANS AND TYPES	STRUCTURAL
S0317	FOOTING DETAILS TYPE 1 PLAN	STRUCTURAL
S0318	FOOTING DETAILS TYPE 1 SECTION	STRUCTURAL
S0319	FOOTING DETAILS TYPE 1A PLAN	STRUCTURAL
S0320	FOOTING DETAILS TYPE 1A SECTIONS	STRUCTURAL
S0321	FOOTING DETAILS TYPE 2 PLAN	STRUCTURAL
S0322	FOOTING DETAILS TYPE 2 SECTIONS	STRUCTURAL
S0323	FOOTING DETAILS TYPE 2A PLAN	STRUCTURAL
S0324	FOOTING DETAILS TYPE 2A SECTIONS	STRUCTURAL
S0325	FOOTING DETAILS TYPE 3 PLAN	STRUCTURAL
S0326	FOOTING DETAILS TYPE 3 SECTIONS	STRUCTURAL
S0327	FOOTING DETAILS TYPE 3A PLAN	STRUCTURAL
S0328	FOOTING DETAILS TYPE 3A SECTIONS	STRUCTURAL
S0329	FOOTING DETAILS TYPE 4 PLAN	STRUCTURAL
S0330	FOOTING DETAILS TYPE 4 SECTIONS	STRUCTURAL
S0331	FOOTING DETAILS TYPE 5 PLAN	STRUCTURAL
S0332	FOOTING DETAILS TYPE 5 SECTIONS	STRUCTURAL
S0333	FOOTING DETAILS TYPE 6 PLAN	STRUCTURAL
S0334	FOOTING DETAILS TYPE 6 SECTIONS	STRUCTURAL
S0335	FOOTING DETAILS TYPE 7 PLAN	STRUCTURAL
S0336	FOOTING DETAILS TYPE 7 SECTIONS	STRUCTURAL
S0337	FOOTING DETAILS POST TENSIONING DETAILS SHEET 1	STRUCTURAL
S0338	FOOTING DETAILS POST TENSIONING DETAILS SHEET 2	STRUCTURAL
S0339	FOOTING DETAILS POST TENSIONING DETAILS SHEET 3	STRUCTURAL
S0401	PIER S12 PLAN AND ELEVATION	STRUCTURAL
S0402	PIER S11 PLAN AND ELEVATION	STRUCTURAL
S0403	PIER S10 PLAN AND ELEVATION	STRUCTURAL
S0404	PIER S9 PLAN AND ELEVATION	STRUCTURAL
S0405	PIER S8 PLAN AND ELEVATION	STRUCTURAL
S0406	PIER S7 PLAN AND ELEVATION	STRUCTURAL
S0407	PIER S6 PLAN AND ELEVATION	STRUCTURAL
S0408	PIER S5 PLAN AND ELEVATION	STRUCTURAL
S0409	PIER S4 PLAN AND ELEVATION	STRUCTURAL

S0410	PIER S3 PLAN AND ELEVATION	STRUCTURAL
S0411	PIER S2 PLAN AND ELEVATION	STRUCTURAL
S0412	PIER N2 PLAN AND ELEVATION	STRUCTURAL
S0413	PIER N3 PLAN AND ELEVATION	STRUCTURAL
S0414	PIER N4 PLAN AND ELEVATION	STRUCTURAL
S0415	PIER N5 PLAN AND ELEVATION	STRUCTURAL
S0416	PIER N6 PLAN AND ELEVATION	STRUCTURAL
S0417	PIER N7 PLAN AND ELEVATION	STRUCTURAL
S0418	PIER N8 PLAN AND ELEVATION	STRUCTURAL
S0419	PIER N9 PLAN AND ELEVATION	STRUCTURAL
S0420	PIER N10 PLAN AND ELEVATION	STRUCTURAL
S0421	PIER N11 PLAN AND ELEVATION	STRUCTURAL
S0422	PIER N12 PLAN AND ELEVATION	STRUCTURAL
S0423	PIER N13 PLAN AND ELEVATION	STRUCTURAL
S0424	PIER N14 PLAN AND ELEVATION	STRUCTURAL
S0425	PIER DRAINAGE PIPE DETAILS SHEET 1	STRUCTURAL
S0426	PIER DRAINAGE PIPE DETAILS SHEET 2	STRUCTURAL
S0427	FIRE STANDPIPE DETAILS SHEET 1	STRUCTURAL
S0428	FIRE STANDPIPE DETAILS SHEET 2	STRUCTURAL
S0429	FIRE STANDPIPE DETAILS SHEET 3	STRUCTURAL
S0430	FIRE STANDPIPE DETAILS SHEET 4	STRUCTURAL
S0501	PRECAST PIER CAP LAYOUT SHEET 1	STRUCTURAL
S0502	PRECAST PIER CAP LAYOUT SHEET 2	STRUCTURAL
S0503	PRECAST PIER CAP LAYOUT SHEET 3	STRUCTURAL
S0504	TYPICAL CIP PIER DETAILS SHEET 1	STRUCTURAL
S0505	TYPICAL CIP PIER DETAILS SHEET 2	STRUCTURAL
S0506	TYPICAL PRECAST SEGMENT DETAILS SHEET 1	STRUCTURAL
S0507	CIP COLUMN AND STRUT REINFORCEMENT SHEET 1	STRUCTURAL
S0508	CIP COLUMN AND STRUT REINFORCEMENT SHEET 2	STRUCTURAL
S0509	CIP COLUMN AND STRUT REINFORCEMENT SHEET 3	STRUCTURAL
S0510	CIP COLUMN AND STRUT REINFORCEMENT SHEET 4	STRUCTURAL
S0511	CIP COLUMN AND STRUT POST TENSIONING DETAILS SHEET 1	STRUCTURAL
S0512	CIP COLUMN AND STRUT POST TENSIONING DETAILS SHEET 2	STRUCTURAL
S0601	TYPE 1 PIER CAP P/T LAYOUT SHEET 1	STRUCTURAL
S0602	TYPE 1 PIER CAP P/T LAYOUT SHEET 2	STRUCTURAL
S0603	TYPE 1 PIER CAP P/T LAYOUT SHEET 3	STRUCTURAL

S0604	TYPE 2 PIER CAP P/T LAYOUT SHEET 1	STRUCTURAL
S0605	TYPE 3 PIER CAP P/T LAYOUT SHEET 1	STRUCTURAL
S0606	PRECAST PIER COLUMN P/T DETAILS SHEET 1	STRUCTURAL
S0607	PRECAST PIER COLUMN P/T DETAILS SHEET 2	STRUCTURAL
S0608	PRECAST PIER COLUMN P/T DETAILS SHEET 3	STRUCTURAL
S0609	PRECAST PIER COLUMN P/T DETAILS SHEET 4	STRUCTURAL
S0701	PRECAST PIER CAP T1-C1 DIMENSIONS AND REINFORCEMENT SHEET 1	STRUCTURAL
S0702	PRECAST PIER CAP T1-C1 DIMENSIONS AND REINFORCEMENT SHEET 2	STRUCTURAL
S0703	PRECAST PIER CAP T1-C1 DIMENSIONS AND REINFORCEMENT SHEET 3	STRUCTURAL
S0704	PRECAST PIER CAP T1-C2 DIMENSIONS AND REINFORCEMENT SHEET 1	STRUCTURAL
S0705	PRECAST PIER CAP T1-C2 DIMENSIONS AND REINFORCEMENT SHEET 2	STRUCTURAL
S0706	PRECAST PIER CAP T1-C3 DIMENSIONS AND REINFORCEMENT SHEET 1	STRUCTURAL
S0707	PRECAST PIER CAP T1-C3 DIMENSIONS AND REINFORCEMENT SHEET 2	STRUCTURAL
S0708	PRECAST COLUMN CAPITAL T1-P1 DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0709	PRECAST SEGMENT TYPE T1 TYPICAL SECTION DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0710	PRECAST SEGMENT TYPE T1-P2 DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0711	PRECAST PIER CAP T2-C1 DIMENSIONS AND REINFORCEMENT SHEET 1	STRUCTURAL
S0712	PRECAST PIER CAP T2-C1 DIMENSIONS AND REINFORCEMENT SHEET 2	STRUCTURAL
S0713	PRECAST COLUMN CAPITAL T2-P1 DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0714	PRECAST SEGMENT TYPE T2 TYPICAL SECTION DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0715	PRECAST PIER CAP T3-C1 DIMENSIONS AND REINFORCEMENT SHEET 1	STRUCTURAL
S0716	PRECAST PIER CAP T3-C1 DIMENSIONS AND REINFORCEMENT SHEET 2	STRUCTURAL
S0717	PRECAST COLUMN CAPITAL T3-P1 DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0718	PRECAST SEGMENT TYPE T3 TYPICAL SECTION DIMENSIONS AND REINFORCEMENT	STRUCTURAL
S0719	POST-TENSIONING SCHEDULE SHEET 1	STRUCTURAL
S0720	POST-TENSIONING SCHEDULE SHEET 2	STRUCTURAL

S0721	POST-TENSIONING SCHEDULE SHEET 3	STRUCTURAL
S0722	POST-TENSIONING SCHEDULE SHEET 4	STRUCTURAL
S0723	POST-TENSIONING SCHEDULE SHEET 5	STRUCTURAL
S0801	ABUTMENT S13 PLAN AND ELEVATION	STRUCTURAL
S0802	ABUTMENT N15 PLAN AND ELEVATION	STRUCTURAL
S0803	ABUTMENT DETAILS SHEET 1	STRUCTURAL
S0804	ABUTMENT DETAILS SHEET 2	STRUCTURAL
S0805	NY APPROACH SLAB PLAN AND SECTION	STRUCTURAL
S0806	NJ APPROACH SLAB PLAN AND SECTION	STRUCTURAL
S0807	APPROACH SLAB DETAILS SHEET 1	STRUCTURAL
S0808	APPROACH SLAB DETAILS SHEET 2	STRUCTURAL
S0901	NEW YORK BEARING LAYOUT	STRUCTURAL
S0902	NEW JERSEY BEARING LAYOUT	STRUCTURAL
S0903	MULTI-ROTATIONAL DISC BEARING PLAN & SECTIONS	STRUCTURAL
S0904	MULTI-ROTATIONAL DISC BEARING DETAILS	STRUCTURAL
S0905	BEARING DETAILS SHEET 1	STRUCTURAL
S0906	BEARING DETAILS SHEET 2	STRUCTURAL
S1001	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 0	STRUCTURAL
S1002	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 1	STRUCTURAL
S1003	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 2	STRUCTURAL
S1004	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 3	STRUCTURAL
S1005	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 4	STRUCTURAL
S1006	SUBSTRUCTURE CONSTRUCTION STAGES STAGE 5	STRUCTURAL
S1101	NORTHBOUND SEGMENT LAYOUT - SHEET 1	STRUCTURAL
S1102	NORTHBOUND SEGMENT LAYOUT - SHEET 2	STRUCTURAL
S1103	NORTHBOUND SEGMENT LAYOUT - SHEET 3	STRUCTURAL
S1104	NORTHBOUND SEGMENT LAYOUT - SHEET 4	STRUCTURAL
S1105	NORTHBOUND SEGMENT LAYOUT - SHEET 5	STRUCTURAL
S1106	NORTHBOUND SEGMENT LAYOUT - SHEET 6	STRUCTURAL
S1107	NORTHBOUND SEGMENT LAYOUT - SHEET 7	STRUCTURAL
S1108	NORTHBOUND SEGMENT LAYOUT - SHEET 8	STRUCTURAL
S1109	NORTHBOUND SEGMENT LAYOUT - SHEET 9	STRUCTURAL
S1110	NORTHBOUND SEGMENT LAYOUT - SHEET 10	STRUCTURAL
S1111	NORTHBOUND SEGMENT LAYOUT - SHEET 11	STRUCTURAL
S1112	NORTHBOUND SEGMENT LAYOUT - SHEET 12	STRUCTURAL
S1113	NORTHBOUND SEGMENT LAYOUT - SHEET 13	STRUCTURAL
S1114	NORTHBOUND SEGMENT LAYOUT - SHEET 14	STRUCTURAL
S1115	NORTHBOUND SEGMENT LAYOUT - SHEET 15	STRUCTURAL
S1116	NORTHBOUND SEGMENT LAYOUT - SHEET 16	STRUCTURAL
S1117	NORTHBOUND SEGMENT LAYOUT - SHEET 17	STRUCTURAL

S1118	NORTHBOUND SEGMENT LAYOUT - SHEET 18	STRUCTURAL
S1119	SOUTHBOUND SEGMENT LAYOUT - SHEET 19	STRUCTURAL
S1120	SOUTHBOUND SEGMENT LAYOUT - SHEET 20	STRUCTURAL
S1121	SOUTHBOUND SEGMENT LAYOUT - SHEET 21	STRUCTURAL
S1122	SOUTHBOUND SEGMENT LAYOUT - SHEET 22	STRUCTURAL
S1123	SOUTHBOUND SEGMENT LAYOUT - SHEET 23	STRUCTURAL
S1124	SOUTHBOUND SEGMENT LAYOUT - SHEET 24	STRUCTURAL
S1125	SOUTHBOUND SEGMENT LAYOUT - SHEET 25	STRUCTURAL
S1126	SOUTHBOUND SEGMENT LAYOUT - SHEET 26	STRUCTURAL
S1127	SOUTHBOUND SEGMENT LAYOUT - SHEET 27	STRUCTURAL
S1128	SOUTHBOUND SEGMENT LAYOUT - SHEET 28	STRUCTURAL
S1129	SOUTHBOUND SEGMENT LAYOUT - SHEET 29	STRUCTURAL
S1130	SOUTHBOUND SEGMENT LAYOUT - SHEET 30	STRUCTURAL
S1131	SOUTHBOUND SEGMENT LAYOUT - SHEET 31	STRUCTURAL
S1132	SOUTHBOUND SEGMENT LAYOUT - SHEET 32	STRUCTURAL
S1133	SOUTHBOUND SEGMENT LAYOUT - SHEET 33	STRUCTURAL
S1134	SOUTHBOUND SEGMENT LAYOUT - SHEET 34	STRUCTURAL
S1135	SOUTHBOUND SEGMENT LAYOUT - SHEET 35	STRUCTURAL
S1136	SOUTHBOUND SEGMENT LAYOUT - SHEET 36	STRUCTURAL
S1201	PIER SEGMENT DIMENSIONS - NB TYPICAL 14' PIER	STRUCTURAL
S1202	PIER SEGMENT DIMENSIONS - NB WIDE 14' PIER	STRUCTURAL
S1203	PIER SEGMENT DIMENSIONS - NB TYPICAL 10' PIER	STRUCTURAL
S1204	PIER SEGMENT DIMENSIONS - NB PIER N14E	STRUCTURAL
S1205	PIER SEGMENT DIMENSIONS - NB WIDE 10' PIER	STRUCTURAL
S1206	PIER SEGMENT DIMENSIONS - SB TYPICAL 14' PIER	STRUCTURAL
S1207	PIER SEGMENT DIMENSIONS - SB WIDE 14' PIER	STRUCTURAL
S1208	PIER SEGMENT DIMENSIONS - SB WIDE 10' PIER	STRUCTURAL
S1209	BEARING JACKING DETAILS - SHEET 1	STRUCTURAL
S1210	BEARING JACKING DETAILS - SHEET 2	STRUCTURAL
S1211	PIER SEGMENT REINFORCEMENT - NB TYPICAL 14' PIER SHEET 1	STRUCTURAL
S1212	PIER SEGMENT REINFORCEMENT - NB TYPICAL 14' PIER SHEET 2	STRUCTURAL
S1213	PIER SEGMENT REINFORCEMENT - NB TYPICAL 14' PIER SHEET 3	STRUCTURAL
S1214	PIER SEGMENT REINFORCEMENT - NB WIDE 14' PIER SHEET 1	STRUCTURAL
S1215	PIER SEGMENT REINFORCEMENT - NB WIDE 14' PIER SHEET 2	STRUCTURAL
S1216	PIER SEGMENT REINFORCEMENT - NB WIDE 14' PIER SHEET 3	STRUCTURAL
S1217	PIER SEGMENT REINFORCEMENT - NB TYPICAL 10'	STRUCTURAL

	PIER SHEET 1	
S1218	PIER SEGMENT REINFORCEMENT - NB TYPICAL 10' PIER SHEET 2	STRUCTURAL
S1219	PIER SEGMENT REINFORCEMENT - NB TYPICAL 10' PIER SHEET 3	STRUCTURAL
S1220	PIER SEGMENT REINFORCEMENT - NB PIER N14E SHEET 1	STRUCTURAL
S1221	PIER SEGMENT REINFORCEMENT - NB PIER N14E SHEET 2	STRUCTURAL
S1222	PIER SEGMENT REINFORCEMENT - NB PIER N14E SHEET 3	STRUCTURAL
S1223	PIER SEGMENT REINFORCEMENT - NB WIDE 10' PIER SHEET 1	STRUCTURAL
S1224	PIER SEGMENT REINFORCEMENT - NB WIDE 10' PIER SHEET 2	STRUCTURAL
S1225	PIER SEGMENT REINFORCEMENT - NB WIDE 10' PIER SHEET 3	STRUCTURAL
S1226	PIER SEGMENT REINFORCEMENT - SB TYPICAL 14' PIER SHEET 1	STRUCTURAL
S1227	PIER SEGMENT REINFORCEMENT - SB TYPICAL 14' PIER SHEET 2	STRUCTURAL
S1228	PIER SEGMENT REINFORCEMENT - SB TYPICAL 14' PIER SHEET 3	STRUCTURAL
S1229	PIER SEGMENT REINFORCEMENT - SB WIDE 14' PIER SHEET 1	STRUCTURAL
S1230	PIER SEGMENT REINFORCEMENT - SB WIDE 14' PIER SHEET 2	STRUCTURAL
S1231	PIER SEGMENT REINFORCEMENT - SB WIDE 14' PIER SHEET 3	STRUCTURAL
S1232	PIER SEGMENT REINFORCEMENT - SB WIDE 10' PIER SHEET 1	STRUCTURAL
S1233	PIER SEGMENT REINFORCEMENT - SB WIDE 10' PIER SHEET 2	STRUCTURAL
S1234	PIER SEGMENT REINFORCEMENT - SB WIDE 10' PIER SHEET 3	STRUCTURAL
S1235	NORTHBOUND PIER SEGMENT POST-TENSION DETAILS	STRUCTURAL
S1236	SOUTHBOUND PIER SEGMENT POST-TENSION DETAILS	STRUCTURAL
S1301	TYPICAL SEGMENT DIMENSIONS - NB CONSTANT DEPTH	STRUCTURAL
S1302	TYPICAL SEGMENT DIMENSIONS - NB VARIABLE DEPTH 14' HAUNCH	STRUCTURAL
S1303	TYPICAL SEGMENT DIMENSIONS - SB CONSTANT DEPTH	STRUCTURAL

S1304	TYPICAL SEGMENT DIMENSIONS - SB VARIABLE DEPTH 14' HAUNCH	STRUCTURAL
S1305	NORTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 1	STRUCTURAL
S1306	NORTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 2	STRUCTURAL
S1307	NORTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 3	STRUCTURAL
S1308	NORTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 1	STRUCTURAL
S1309	NORTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 2	STRUCTURAL
S1310	NORTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 3	STRUCTURAL
S1311	SOUTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 1	STRUCTURAL
S1312	SOUTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 2	STRUCTURAL
S1313	SOUTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 3	STRUCTURAL
S1314	SOUTHBOUND SEGMENT REINFORCEMENT - CONSTANT DEPTH SHEET 4	STRUCTURAL
S1315	SOUTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 1	STRUCTURAL
S1316	SOUTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 2	STRUCTURAL
S1317	SOUTHBOUND SEGMENT REINFORCEMENT - VARIABLE DEPTH 14' SHEET 3	STRUCTURAL
S1318	NORTHBOUND SEGMENT REINFORCEMENT - SCHEDULE SHEET 1	STRUCTURAL
S1319	NORTHBOUND SEGMENT REINFORCEMENT - SCHEDULE SHEET 2	STRUCTURAL
S1320	SOUTHBOUND SEGMENT REINFORCEMENT - SCHEDULE SHEET 1	STRUCTURAL
S1321	SOUTHBOUND SEGMENT REINFORCEMENT - SCHEDULE SHEET 2	STRUCTURAL
S1401	EXPANSION JOINT SEGMENT DIMENSIONS - NB ABUTMENT	STRUCTURAL
S1402	EXPANSION JOINT SEGMENT DIMENSIONS - NB TOWER	STRUCTURAL
S1403	EXPANSION JOINT SEGMENT DIMENSIONS - NB INTERIOR PIER	STRUCTURAL
S1404	EXPANSION JOINT SEGMENT DIMENSIONS - SB ABUTMENT	STRUCTURAL
S1405	EXPANSION JOINT SEGMENT DIMENSIONS - SB	STRUCTURAL

	TOWER	
S1406	EXPANSION JOINT SEGMENT DIMENSIONS - SB INTERIOR PIER	STRUCTURAL
S1407	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 1	STRUCTURAL
S1408	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 2	STRUCTURAL
S1409	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 3	STRUCTURAL
S1410	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 4	STRUCTURAL
S1411	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 5	STRUCTURAL
S1412	EXPANSION JOINT SEGMENT REINFORCEMENT - NB DETAILS 6	STRUCTURAL
S1413	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 1	STRUCTURAL
S1414	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 2	STRUCTURAL
S1415	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 3	STRUCTURAL
S1416	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 4	STRUCTURAL
S1417	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 5	STRUCTURAL
S1418	EXPANSION JOINT SEGMENT REINFORCEMENT - SB DETAILS 6	STRUCTURAL
S1419	EXPANSION JOINT SEGMENT POST-TENSION DETAILS - NORTHBOUND	STRUCTURAL
S1420	EXPANSION JOINT SEGMENT POST-TENSION DETAILS - SOUTHBOUND	STRUCTURAL
S1421	CLOSURE SEGMENT REINFORCEMENT - NB APPROACH SHEET 1	STRUCTURAL
S1422	CLOSURE SEGMENT REINFORCEMENT - NB APPROACH SHEET 2	STRUCTURAL
S1423	CLOSURE SEGMENT REINFORCEMENT - SB APPROACH SHEET 1	STRUCTURAL
S1424	CLOSURE SEGMENT REINFORCEMENT - SB APPROACH SHEET 2	STRUCTURAL
S1425	CLOSURE SEGMENT P/T DEVIATOR BLOCK - NB DIMENSIONS	STRUCTURAL
S1426	CLOSURE SEGMENT P/T DEVIATOR BLOCK - NB REINFORCEMENT	STRUCTURAL
S1427	CLOSURE SEGMENT P/T DEVIATOR BLOCK - SB DIMENSIONS	STRUCTURAL

S1428	CLOSURE SEGMENT P/T DEVIATOR BLOCK - SB REINFORCEMENT	STRUCTURAL
S1501	NORTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 1	STRUCTURAL
S1502	NORTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 2	STRUCTURAL
S1503	NORTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 3	STRUCTURAL
S1504	SOUTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 1	STRUCTURAL
S1505	SOUTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 2	STRUCTURAL
S1506	SOUTHBOUND TRANSVERSE POST-TENSIONING LAYOUT - SHEET 3	STRUCTURAL
S1507	TRANSVERSE POST-TENSIONING DETAILS - SHEET 1	STRUCTURAL
S1508	NB BULKHEAD AND SHEAR KEY DETAILS	STRUCTURAL
S1509	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S12E	STRUCTURAL
S1510	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S11E	STRUCTURAL
S1511	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S10E	STRUCTURAL
S1512	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S9E	STRUCTURAL
S1513	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S8E SHEET 1	STRUCTURAL
S1514	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S8E SHEET 2	STRUCTURAL
S1515	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S7E	STRUCTURAL
S1516	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S6E	STRUCTURAL
S1517	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S5E	STRUCTURAL
S1518	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S4E	STRUCTURAL
S1519	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S3E SHEET 1	STRUCTURAL
S1520	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S3E SHEET 2	STRUCTURAL
S1521	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S2E SHEET 1	STRUCTURAL
S1522	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S2E SHEET 2	STRUCTURAL

S1523	NORTHBOUND POST-TENSIONING LAYOUT - SPAN S1E	STRUCTURAL
S1524	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N1E	STRUCTURAL
S1525	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N2E	STRUCTURAL
S1526	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N3E	STRUCTURAL
S1527	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N4E	STRUCTURAL
S1528	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N5E	STRUCTURAL
S1529	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N6E	STRUCTURAL
S1530	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N7E	STRUCTURAL
S1531	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N8E	STRUCTURAL
S1532	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N9E	STRUCTURAL
S1533	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N10E	STRUCTURAL
S1534	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N11E	STRUCTURAL
S1535	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N12E	STRUCTURAL
S1536	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N13E	STRUCTURAL
S1537	NORTHBOUND POST-TENSIONING LAYOUT - SPAN N14E	STRUCTURAL
S1538	SB BULKHEAD AND SHEAR KEY DETAILS	STRUCTURAL
S1539	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S12W	STRUCTURAL
S1540	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S11W	STRUCTURAL
S1541	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S10W	STRUCTURAL
S1542	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S9W	STRUCTURAL
S1543	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S8W	STRUCTURAL
S1544	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S7W SHEET 1	STRUCTURAL
S1545	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S7W SHEET 2	STRUCTURAL

S1546	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S6W	STRUCTURAL
S1547	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S5W	STRUCTURAL
S1548	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S4W	STRUCTURAL
S1549	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S3W SHEET 1	STRUCTURAL
S1550	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S3W SHEET 2	STRUCTURAL
S1551	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S2W SHEET 1	STRUCTURAL
S1552	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S2W SHEET 2	STRUCTURAL
S1553	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN S1W	STRUCTURAL
S1554	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N1W	STRUCTURAL
S1555	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N2W	STRUCTURAL
S1556	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N3W	STRUCTURAL
S1557	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N4W	STRUCTURAL
S1558	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N5W	STRUCTURAL
S1559	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N6W	STRUCTURAL
S1560	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N7W	STRUCTURAL
S1561	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N8W	STRUCTURAL
S1562	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N9W	STRUCTURAL
S1563	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N10W	STRUCTURAL
S1564	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N11W	STRUCTURAL
S1565	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N12W	STRUCTURAL
S1566	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N13W	STRUCTURAL
S1567	SOUTHBOUND POST-TENSIONING LAYOUT - SPAN N14W	STRUCTURAL
S1601	NB SB NEW YORK FUTURE TENDON	STRUCTURAL

	ARRANGEMENT - SHEET 1	
S1602	NB SB NEW JERSEY FUTURE TENDON ARRANGEMENT - SHEET 2	STRUCTURAL
S1603	FUTURE TENDON TYPES-I TO III - SHEET 3	STRUCTURAL
S1604	FUTURE TENDON TYPES-IV TO VI - SHEET 4	STRUCTURAL
S1605	FUTURE TENDON SECTIONS-I - SHEET 5	STRUCTURAL
S1606	FUTURE TENDON SECTIONS-II - SHEET 6	STRUCTURAL
S1607	FUTURE TENDON DETAILS - SHEET 7	STRUCTURAL
S1701	CANTILEVER POST-TENSIONING DETAILS - 8'-0" SEGMENTS SHEET 1	STRUCTURAL
S1702	CANTILEVER POST-TENSIONING DETAILS - 8'-0" SEGMENTS SHEET 2	STRUCTURAL
S1703	CANTILEVER POST-TENSIONING DETAILS - 10'-0" SEGMENTS	STRUCTURAL
S1704	CONTINUITY POST-TENSIONING DETAILS	STRUCTURAL
S1705	POST-TENSIONING GROUTING DETAILS	STRUCTURAL
S1706	P/T ANCHOR BLOCK DIMENSIONS - NB SHEET 1	STRUCTURAL
S1707	P/T ANCHOR BLOCK DIMENSIONS - NB SHEET 2	STRUCTURAL
S1708	P/T ANCHOR BLOCK DIMENSIONS - SB SHEET 1	STRUCTURAL
S1709	P/T ANCHOR BLOCK DIMENSIONS - SB SHEET 2	STRUCTURAL
S1710	P/T TOP SLAB ANCHOR BLOCK - NB DIMENSIONS SHEET 1	STRUCTURAL
S1711	P/T TOP SLAB ANCHOR BLOCK - NB DIMENSIONS SHEET 2	STRUCTURAL
S1712	P/T TOP SLAB ANCHOR BLOCK - SB DIMENSIONS SHEET 1	STRUCTURAL
S1713	P/T TOP SLAB ANCHOR BLOCK - SB DIMENSIONS SHEET 2	STRUCTURAL
S1714	P/T ANCHOR BLOCK REINFORCEMENT - NB SHEET 1	STRUCTURAL
S1715	P/T ANCHOR BLOCK REINFORCEMENT - NB SHEET 2	STRUCTURAL
S1716	P/T ANCHOR BLOCK REINFORCEMENT - SB SHEET 1	STRUCTURAL
S1717	P/T ANCHOR BLOCK REINFORCEMENT - SB SHEET 2	STRUCTURAL
S1718	P/T TOP SLAB ANCHOR BLOCK - NB REINFORCEMENT SHEET 1	STRUCTURAL
S1719	P/T TOP SLAB ANCHOR BLOCK - NB REINFORCEMENT SHEET 2	STRUCTURAL
S1720	P/T TOP SLAB ANCHOR BLOCK - SB REINFORCEMENT SHEET 1	STRUCTURAL
S1721	P/T TOP SLAB ANCHOR BLOCK - SB REINFORCEMENT SHEET 2	STRUCTURAL
S1722	ERECTION P/T BAR NB 14' PIER DETAILS	STRUCTURAL
S1723	ERECTION P/T BAR SB 14' PIER DETAILS	STRUCTURAL
S1724	ERECTION P/T BAR NB 10' PIER DETAILS 1	STRUCTURAL

S1725	ERECTION P/T BAR NB 10' PIER DETAILS 2	STRUCTURAL
S1726	ERECTION P/T BAR SB 10' PIER DETAILS	STRUCTURAL
S1727	ERECTION P/T BAR EXPANSION PIER TEMP BLOCK DETAILS	STRUCTURAL
S1728	ERECTION P/T BAR NB EXPANSION PIER DETAILS	STRUCTURAL
S1729	ERECTION P/T BAR SB EXPANSION PIER DETAILS	STRUCTURAL
S1730	ERECTION P/T BAR TYPICAL DETAILS 1	STRUCTURAL
S1731	ERECTION P/T BAR TYPICAL DETAILS 2	STRUCTURAL
S1732	ERECTION P/T BAR TYPICAL DETAILS 3	STRUCTURAL
S1801	NB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 1	STRUCTURAL
S1802	NB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 2	STRUCTURAL
S1803	NB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 3	STRUCTURAL
S1804	NB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 4	STRUCTURAL
S1805	NB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 5	STRUCTURAL
S1806	SB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 1	STRUCTURAL
S1807	SB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 2	STRUCTURAL
S1808	SB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 3	STRUCTURAL
S1809	SB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 4	STRUCTURAL
S1810	SB LONGITUDINAL POST-TENSIONING SCHEDULE - SHEET 5	STRUCTURAL
S1901	DECK EXPANSION JOINT DETAILS - NB INTERIOR PIER - SHEET 1	STRUCTURAL
S1902	DECK EXPANSION JOINT DETAILS - NB INTERIOR PIER - SHEET 2	STRUCTURAL
S1903	DECK EXPANSION JOINT DETAILS - NB ABUTMENTS - SHEET 1	STRUCTURAL
S1904	DECK EXPANSION JOINT DETAILS - NB ABUTMENTS - SHEET 2	STRUCTURAL
S1905	DECK EXPANSION JOINT DETAILS - SB INTERIOR PIERS	STRUCTURAL
S1906	DECK EXPANSION JOINT DETAILS - SB ABUTMENTS	STRUCTURAL
S1907	DECK EXPANSION JOINT DETAILS - COVER PLATE DETAILS - SHEET 1	STRUCTURAL
S1908	DECK EXPANSION JOINT DETAILS - COVER PLATE DETAILS - SHEET 2	STRUCTURAL

S1909	DECK EXPANSION JOINT DETAILS - TABLES & NOTES	STRUCTURAL
S1910	DECK DRAINAGE DETAILS - SHEET 1	STRUCTURAL
S1911	DECK DRAINAGE DETAILS - SHEET 2	STRUCTURAL
S1912	DECK DRAINAGE DETAILS - SHEET 3	STRUCTURAL
S1913	LUMINAIRE SUPPORT DETAILS - SHEET 1	STRUCTURAL
S1914	LUMINAIRE SUPPORT DETAILS - SHEET 2	STRUCTURAL
S1915	UTILITY SUPPORT DETAILS - SHEET 1	STRUCTURAL
S1916	UTILITY SUPPORT DETAILS - SHEET 2	STRUCTURAL
S1917	UTILITY SUPPORT DETAILS - SHEET 3	STRUCTURAL
S1918	UTILITY SUPPORT DETAILS - SHEET 4	STRUCTURAL
S1919	ACCESS OPENING DETAILS	STRUCTURAL
S1920	ACCESS OPENING HATCHES	STRUCTURAL
S1921	VERMIN GUARD DETAILS	STRUCTURAL
S2001	NORTHBOUND CONSTRUCTION SEQUENCE - SHEET 1	STRUCTURAL
S2002	NORTHBOUND CONSTRUCTION SEQUENCE - SHEET 2	STRUCTURAL
S2003	NORTHBOUND CONSTRUCTION SEQUENCE - SHEET 3	STRUCTURAL
S2004	NORTHBOUND CONSTRUCTION SEQUENCE - SHEET 4	STRUCTURAL
S2005	NORTHBOUND CONSTRUCTION SEQUENCE - SHEET 5	STRUCTURAL
S2006	CONSTANT DEPTH CANTILEVER ERECTION PROCEDURE 1	STRUCTURAL
S2007	CONSTANT DEPTH CANTILEVER ERECTION PROCEDURE 2	STRUCTURAL
S2008	EXPANSION PIER CANTILEVER ERECTION PROCEDURE	STRUCTURAL
S2009	HAUNCHED CANTILEVER ERECTION PROCEDURE	STRUCTURAL
S2010	ERECTION SCHEMATIC TYPICAL SECTIONS	STRUCTURAL
S2011	GANTRY LOADING SCHEDULES	STRUCTURAL
G0401	TITLE SHEET	STRUCTURAL
S2101	NEW YORK APPROACH CATWALK PLAN SHEET 1	STRUCTURAL
S2102	NEW YORK APPROACH CATWALK PLAN SHEET 2	STRUCTURAL
S2103	NEW YORK APPROACH CATWALK PLAN SHEET 3	STRUCTURAL
S2104	NEW JERSEY APPROACH CATWALK PLAN SHEET 4	STRUCTURAL
S2105	NEW JERSEY APPROACH CATWALK PLAN SHEET 5	STRUCTURAL
S2106	NEW JERSEY APPROACH CATWALK PLAN SHEET 6	STRUCTURAL
S2107	APPROACH STRUCTURE CATWALK PART PLAN AND ELEVATION	STRUCTURAL
S2108	APPROACH STRUCTURE CATWALK TYPICAL	STRUCTURAL

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S2109	APPROACH STRUCTURE CATWALK DETAILS SHEET 1	STRUCTURAL
S2110	APPROACH STRUCTURE CATWALK DETAILS SHEET 2	STRUCTURAL
S2111	APPROACH STRUCTURE CATWALK DETAILS SHEET 3	STRUCTURAL
S2112	APPROACH STRUCTURE MAIN TOWER ELECTRICAL ROOM ACCESS DETAILS SHEET 1	STRUCTURAL
S2113	APPROACH STRUCTURE MAIN TOWER ELECTRICAL ROOM ACCESS DETAILS SHEET 2	STRUCTURAL
S2114	NEW YORK APPROACH CATWALK ACCESS TOWER PLANS	STRUCTURAL
S2115	NEW YORK APPROACH CATWALK ACCESS TOWER ELEVATIONS AND SECTIONS	STRUCTURAL
S2116	NEW YORK APPROACH CATWALK ACCESS TOWER AT HATCH ELEVATIONS	STRUCTURAL
S2117	NEW YORK APPROACH CATWALK ACCESS TOWER AT HATCH FOOTING PLAN	STRUCTURAL
S2118	NEW JERSEY APPROACH CATWALK ACCESS TOWER PLANS	STRUCTURAL
S2119	NEW JERSEY APPROACH CATWALK ACCESS TOWER ELEVATIONS AND SECTIONS	STRUCTURAL
S2120	NEW JERSEY APPROACH CATWALK ACCESS TOWER AT HATCH ELEVATIONS	STRUCTURAL
S2121	NEW JERSEY APPROACH CATWALK ACCESS TOWER AT HATCH FOOTING PLAN	STRUCTURAL
S2122	APPROACH STRUCTURE CATWALK ACCESS TOWER DETAILS SHEET 1	STRUCTURAL
S2123	APPROACH STRUCTURE CATWALK ACCESS TOWER DETAILS SHEET 2	STRUCTURAL
S2124	APPROACH STRUCTURE CATWALK ACCESS TOWER AT HATCH DETAILS SHEET 1	STRUCTURAL
S2125	APPROACH STRUCTURE CATWALK ACCESS TOWER AT HATCH DETAILS SHEET 2	STRUCTURAL
S2126	APPROACH STRUCTURE PIER CAP RAILING PLAN AND ELEVATION	STRUCTURAL
S2127	APPROACH STRUCTURE PIER CAP RAILING DETAILS	STRUCTURAL
S2201	RETAINING WALL NOTES AND DETAILS SHEET 1	STRUCTURAL
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S2204	RETAINING WALL NO. 2 PLAN & ELEVATION SHEET 1	STRUCTURAL

S2205	RETAINING WALL NO. 2 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2206	RETAINING WALL NO. 3 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2207	RETAINING WALL NO. 3 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2208	RETAINING WALL NO. 4 PLAN & ELEVATION SHEET 1	STRUCTURAL
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S2210	RETAINING WALL NO. 5 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2211	RETAINING WALL NO. 5 PLAN & ELEVATION SHEET 3	STRUCTURAL
S2212	RETAINING WALL NO. 6 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2213	RETAINING WALL NO. 6 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2214	RETAINING WALL NO. 6 PLAN & ELEVATION SHEET 3	STRUCTURAL
S2215	RETAINING WALL NO. 7 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2216	RETAINING WALL NO. 7 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2217	RETAINING WALL NO. 7 PLAN & ELEVATION SHEET 3	STRUCTURAL
S2218	RETAINING WALL NO. 8 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2219	RETAINING WALL NO. 8 PLAN & ELEVATION SHEET 2	STRUCTURAL
S2220	RETAINING WALL NO. 9 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2221	RETAINING WALL NO. 10 PLAN & ELEVATION SHEET 1	STRUCTURAL
S2222	RETAINING WALL CROSS SECTION SHEET 1	STRUCTURAL
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S2225	RETAINING WALL LIGHTPOLE SUPPORT DETAILS SHEET 1	STRUCTURAL
S2226	NY TEMPORARY RETAINING WALL GENERAL PLAN	STRUCTURAL
S2227	NY TEMPORARY RETAINING WALL PLAN AND ELEVATION SHEET 1	STRUCTURAL
S2228	NY TEMPORARY RETAINING WALL PLAN AND ELEVATION SHEET 2	STRUCTURAL
S2229	NJ TEMPORARY RETAINING WALL GENERAL PLAN	STRUCTURAL

S2230	NJ TEMPORARY RETAINING WALL PLAN AND ELEVATION SHEET 1	STRUCTURAL
S2231	NJ TEMPORARY RETAINING WALL PLAN AND ELEVATION SHEET 2	STRUCTURAL
S2232	NJ TEMPORARY RETAINING WALL PLAN AND ELEVATION SHEET 3	STRUCTURAL
S2233	TEMPORARY RETAINING WALL DETAILS	STRUCTURAL
S2301	EXISTING STRUCTURE DEMOLITION GENERAL NOTES	STRUCTURAL
S2302	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 1	STRUCTURAL
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S2304	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 3	STRUCTURAL
S2305	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 4	STRUCTURAL
S2306	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 5	STRUCTURAL
S2307	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 6	STRUCTURAL
S2308	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 7	STRUCTURAL
S2309	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 8	STRUCTURAL
S2310	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 9	STRUCTURAL
S2311	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 10	STRUCTURAL
S2312	EXISTING STRUCTURE DEMOLITION PLAN AND ELEVATION SHEET 11	STRUCTURAL
S2313	EXISTING STRUCTURE DEMOLITION SECTIONS SHEET 1	STRUCTURAL
S2314	EXISTING STRUCTURE DEMOLITION SECTIONS SHEET 2	STRUCTURAL
S2315	EXISTING STRUCTURE DEMOLITION SECTIONS SHEET 3	STRUCTURAL
S2316	EXISTING STRUCTURE DEMOLITION SECTIONS SHEET 4	STRUCTURAL
S2317	SUMMARY TABLES FOR EXISTING MEMBERS	STRUCTURAL
S2318	EXISTING TOLL PLAZA REMOVAL PLAN AND ELEVATION	STRUCTURAL
S2401	EXISTING SIDEWALK CONVERSION WORKING PLAN SHEET 1	STRUCTURAL
S2402	EXISTING SIDEWALK CONVERSION WORKING	STRUCTURAL

	PLAN SHEET 2	
S2403	EXISTING SIDEWALK CONVERSION WORKING PLAN SHEET 3	STRUCTURAL
S2404	EXISTING SIDEWALK CONVERSION WORKING PLAN SHEET 4	STRUCTURAL
S2405	EXISTING SIDEWALK CONVERSION FOOTING LOCATION PLAN	STRUCTURAL
S2406	EXISTING SIDEWALK CONVERSION FOOTING DETAILS	STRUCTURAL
S2407	EXISTING SIDEWALK CONVERSION PIER 16S TO 15S SHEET 1	STRUCTURAL
S2408	EXISTING SIDEWALK CONVERSION PIER 16S TO 15S SHEET 2	STRUCTURAL
S2409	EXISTING SIDEWALK CONVERSION PIER 15S TO 13S SHEET 1	STRUCTURAL
S2410	EXISTING SIDEWALK CONVERSION PIER 15S TO 13S SHEET 2	STRUCTURAL
S2411	EXISTING SIDEWALK CONVERSION PIER 15S TO 13S SHEET 3	STRUCTURAL
S2412	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 1	STRUCTURAL
S2413	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 2	STRUCTURAL
S2414	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 3	STRUCTURAL
S2415	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 4	STRUCTURAL
S2416	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 5	STRUCTURAL
S2417	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 6	STRUCTURAL
S2418	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 7	STRUCTURAL
S2419	EXISTING SIDEWALK CONVERSION PIERS 13S TO 3S AND 3N TO 19N SHEET 8	STRUCTURAL
S2420	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 1	STRUCTURAL
S2421	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 2	STRUCTURAL
S2422	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 3	STRUCTURAL
S2423	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 4	STRUCTURAL
S2424	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 5	STRUCTURAL

S2425	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 6	STRUCTURAL
S2426	EXISTING SIDEWALK CONVERSION PIERS 3S TO PP5S AND 3N TO PP5N DETAIL 7	STRUCTURAL
S2427	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 TYPICAL FRAMING PLAN	STRUCTURAL
S2428	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14DECK REINFORCING PLAN	STRUCTURAL
S2429	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 1	STRUCTURAL
S2430	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 2	STRUCTURAL
S2431	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 3	STRUCTURAL
S2432	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 4	STRUCTURAL
S2433	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 5	STRUCTURAL
S2434	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 6	STRUCTURAL
S2435	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 7	STRUCTURAL
S2436	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 8	STRUCTURAL
S2437	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 9	STRUCTURAL
S2438	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 10	STRUCTURAL
S2439	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 11	STRUCTURAL
S2440	EXISTING SIDEWALK CONVERSION PIERS B0 TO B14 DETAIL 12	STRUCTURAL
S2441	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 1	STRUCTURAL
S2442	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 2	STRUCTURAL
S2443	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 3	STRUCTURAL
S2444	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 4	STRUCTURAL
S2445	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 5	STRUCTURAL
S2446	EXISTING SIDEWALK CONVERSION JULIETTE STREET AND WEST 4TH STREET SPANS DETAIL 6	STRUCTURAL
S2447	EXISTING SIDEWALK CONVERSION N. ABUT, WEST	STRUCTURAL

	4TH STREET TO PIER B24 DETAIL 1	
S2448	EXISTING SIDEWALK CONVERSION N. ABUT, WEST 4TH STREET TO PIER B24 DETAIL 2	STRUCTURAL
S2449	EXISTING SIDEWALK CONVERSION N. ABUT, WEST 4TH STREET TO PIER B24 DETAIL 3	STRUCTURAL
S2450	EXISTING SIDEWALK CONVERSION N. ABUT, WEST 4TH STREET TO PIER B24 DETAIL 4	STRUCTURAL
S2451	EXISTING SIDEWALK CONVERSION N. ABUT, WEST 4TH STREET TO PIER B24 DETAIL 5	STRUCTURAL
S2452	EXISTING SIDEWALK CONVERSION N. ABUT, WEST 4TH STREET TO PIER B24 DETAIL 6	STRUCTURAL
S2453	EXISTING SIDEWALK CONVERSION TEMPORARY LIGHT POLE SUPPORT DETAIL 1	STRUCTURAL
S2454	EXISTING SIDEWALK CONVERSION TEMPORARY LIGHT POLE SUPPORT DETAIL 2	STRUCTURAL
S2455	EXISTING SIDEWALK CONVERSION TEMPORARY CONCRETE BARRIER DETAILS	STRUCTURAL
S2456	EXISTING SIDEWALK CONVERSION TEMPORARY BARRIER ALIGNMENT SHEET 1	STRUCTURAL
S2457	EXISTING SIDEWALK CONVERSION TEMPORARY BARRIER ALIGNMENT SHEET 2	STRUCTURAL
S2501	TEMPORARY SHORING AT PIER S6E DETAILS	STRUCTURAL
S2502	TEMPORARY SHORING AT PIER S7E DETAILS SHEET 1	STRUCTURAL
S2503	TEMPORARY SHORING AT PIER S7E DETAILS SHEET 2	STRUCTURAL
S2504	TEMPORARY SHORING AT PIER S8E DETAILS	STRUCTURAL
S2505	TEMPORARY SHORING AT PIER S9E DETAILS	STRUCTURAL
S2506	TEMPORARY SHORING AT PIER N10E DETAILS	STRUCTURAL
S2507	TEMPORARY SHORING AT PIER N11 DETAILS	STRUCTURAL
S2508	TEMPORARY SHORING AT PIER N12 DETAILS	STRUCTURAL
S2509	TEMPORARY SHORING AT PIER N13 DETAILS	STRUCTURAL
S2510	TEMPORARY SHORING AT PIER N14 DETAILS	STRUCTURAL
S2511	TEMPORARY SHORING LOCATION AND LOADING SUMMARY	STRUCTURAL
S2601	TEMPORARY TOLL GANTRY #1 PLAN & SECTION	STRUCTURAL
S2602	TEMPORARY TOLL GANTRY #2 PLAN & SECTION	STRUCTURAL
S2603	TEMPORARY TOLL GANTRY #1 & #2 TYPICAL SECTIONS & DETAILS SHEET 1	STRUCTURAL
S2604	TEMPORARY TOLL GANTRY #1 & #2 TYPICAL SECTIONS & DETAILS SHEET 2	STRUCTURAL
S2605	PERMANENT TOLL GANTRY PLAN	STRUCTURAL
S2606	TOLL GANTRY TYPICAL CROSS SECTION AND ELEVATION	STRUCTURAL

S2607	TOLL GANTRY FRAMING PLANS	STRUCTURAL
S2608	TOLL GANTRY DETAILS SHEET 1	STRUCTURAL
S2609	TOLL GANTRY DETAILS SHEET 2	STRUCTURAL
S2610	TOLL GANTRY DETAILS SHEET 3	STRUCTURAL
S2701	SPAN SIGN STRUCTURE PLAN AND ELEVATION SHEET 1	STRUCTURAL
S2702	SPAN SIGN STRUCTURE PLAN AND ELEVATION SHEET 2	STRUCTURAL
S2703	SPAN SIGN STRUCTURE PLAN AND ELEVATION SHEET 3	STRUCTURAL
S2704	SPAN SIGN STRUCTURE PLAN AND ELEVATION SHEET 4	STRUCTURAL
S2705	SPAN SIGN STRUCTURE TYPICAL TRUSS PLAN AND ELEVATION	STRUCTURAL
S2706	SPAN SIGN STRUCTURE TYPICAL DETAILS SHEET 1	STRUCTURAL
S2707	SPAN SIGN STRUCTURE TYPICAL DETAILS SHEET 2	STRUCTURAL
S2708	SPAN SIGN STRUCTURE TYPICAL DETAILS SHEET 3	STRUCTURAL
S2709	SPAN SIGN STRUCTURE TYPICAL DETAILS SHEET 4	STRUCTURAL
S2710	CANTILEVER SIGN STRUCTURE ELEVATIONS SHEET 1	STRUCTURAL
S2711	CANTILEVER SIGN STRUCTURE ELEVATIONS SHEET 2	STRUCTURAL
S2712	CANTILEVER SIGN STRUCTURE TYPICAL TRUSS ELEVATION	STRUCTURAL
S2713	CANTILEVER SIGN STRUCTURE TYPICAL DETAILS SHEET 1	STRUCTURAL
S2714	CANTILEVER SIGN STRUCTURE TYPICAL DETAILS SHEET 2	STRUCTURAL
S2715	CANTILEVER SIGN STRUCTURE TYPICAL DETAILS SHEET 3	STRUCTURAL
S2716	SIGN STRUCTURE TYPICAL BASE AND CAP DETAILS	STRUCTURAL
S2717	SIGN STRUCTURE SIGN PANEL ATTACHMENT DETAILS	STRUCTURAL
S2718	SIGN STRUCTURE TYPICAL FOUNDATION DETAILS SHEET 1	STRUCTURAL
S2719	SIGN STRUCTURE TYPICAL FOUNDATION DETAILS SHEET 2	STRUCTURAL
S2720	SIGN SUPPORT AT PIER S2 PLAN AND ELEVATION	STRUCTURAL
S2721	SIGN SUPPORT AT PIER S5 PLAN AND ELEVATION	STRUCTURAL
S2722	SIGN SUPPORT AT PIER S10 PLAN AND ELEVATION	STRUCTURAL
S2723	SIGN SUPPORT AT PIER N2 PLAN AND ELEVATION	STRUCTURAL
S2724	SIGN SUPPORT AT PIER N7 PLAN AND ELEVATION	STRUCTURAL
S2725	SIGN SUPPORT AT PIER N13 PLAN AND ELEVATION	STRUCTURAL

S2726	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 1	STRUCTURAL
S2727	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 2	STRUCTURAL
S2728	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 3	STRUCTURAL
S2729	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 4	STRUCTURAL
S2730	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 5	STRUCTURAL
S2731	PIER SIGN SUPPORT BRACKET SECTIONS AND DETAILS SHEET 6	STRUCTURAL
S2732	OVERHEAD SPAN VMS SUPPORT STRUCTURE - GENERAL NOTES	STRUCTURAL
S2733	OVERHEAD SPAN VMS SUPPORT STRUCTURE - PLAN AND ELEVATION - STRUCTURE MOUNTED I	STRUCTURAL
S2734	OVERHEAD SPAN VMS SUPPORT STRUCTURE - PLAN AND ELEVATION - STRUCTURE MOUNTED II	STRUCTURAL
S2735	OVERHEAD SPAN VMS SUPPORT STRUCTURE - PLAN AND ELEVATION - GROUND MOUNTED	STRUCTURAL
S2736	OVERHEAD SPAN VMS SUPPORT STRUCTURE - DRILLED SHAFT FOUNDATION DETAILS	STRUCTURAL
S2737	OVERHEAD SPAN VMS SUPPORT STRUCTURE - TRUSS AND FIELD SPLICE DETAILS	STRUCTURAL
S2738	OVERHEAD SPAN VMS SUPPORT STRUCTURE - TRUSS AND FENCE DETAILS	STRUCTURAL
S2739	OVERHEAD SPAN VMS SUPPORT STRUCTURE - DOOR DETAILS	STRUCTURAL
S2740	OVERHEAD SPAN VMS SUPPORT STRUCTURE - END FRAME DETAILS - STRUCTURE MOUNTED	STRUCTURAL
S2741	OVERHEAD SPAN VMS SUPPORT STRUCTURE - END FRAME DETAILS - GROUND MOUNTED	STRUCTURAL
S2742	OVERHEAD SPAN VMS SUPPORT STRUCTURE - ACCESS LADDER AND PLATFORM DETAILS I	STRUCTURAL
S2743	OVERHEAD SPAN VMS SUPPORT STRUCTURE - ACCESS LADDER AND PLATFORM DETAILS II	STRUCTURAL
S2744	OVERHEAD SPAN VMS SUPPORT STRUCTURE - EQUIPMENT LAYOUT PLAN	STRUCTURAL
S2745	OVERHEAD SPAN VMS SUPPORT STRUCTURE - CABLE ROUTING DETAILS	STRUCTURAL
S2746	OVERHEAD SPAN VMS SUPPORT STRUCTURE - EQUIPMENT MOUNTING DETAILS I	STRUCTURAL
S2747	OVERHEAD SPAN VMS SUPPORT STRUCTURE - EQUIPMENT MOUNTING DETAILS II	STRUCTURAL
S2748	OVERHEAD SPAN VMS SUPPORT STRUCTURE -	STRUCTURAL

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S2749	MISCELLANEOUS EQUIPMENT MOUNTING DETAILS I	STRUCTURAL
S2750	MISCELLANEOUS EQUIPMENT MOUNTING DETAILS II	STRUCTURAL
G0501	TITLE SHEET	STRUCTURAL
S2801	ARCH MODIFICATION AND REPAIR NOTES	STRUCTURAL
S2802	TYPICAL SECTION - EXISTING ARCH	STRUCTURAL
S2803	TYPICAL SECTIONS - ARCH FLOOR AT SUSPENDERS AND BETWEEN SUSPENDERS	STRUCTURAL
S2804	TYPICAL SECTION - ARCH FLOOR AT COLUMN AND CATWALK UTILITY LAYOUT	STRUCTURAL
S2805	GEOMETRY CONTROL DATA - SHEET 1	STRUCTURAL
S2806	GEOMETRY CONTROL DATA - SHEET 2	STRUCTURAL
S2807	GEOMETRY CONTROL DATA - SHEET 3	STRUCTURAL
S2808	GEOMETRY CONTROL DATA - SHEET 4	STRUCTURAL
S2901	NY ABUTMENT: PLAN, ELEVATION AND SECTION	STRUCTURAL
S2902	NY ABUTMENT: ELEVATIONS	STRUCTURAL
S2903	NJ ABUTMENT: PLAN, ELEVATION AND SECTION	STRUCTURAL
S2904	NJ ABUTMENT: ELEVATIONS	STRUCTURAL
S2905	NY ABUTMENT: TOWER PEDESTAL DETAILS SHEET 1	STRUCTURAL
S2906	NY ABUTMENT: TOWER PEDESTAL DETAILS SHEET 2	STRUCTURAL
S2907	NY ABUTMENT: TOWER PEDESTAL DETAILS SHEET 3	STRUCTURAL
S2908	NJ ABUTMENT: TOWER PEDESTAL DETAILS SHEET 1	STRUCTURAL
S2909	NJ ABUTMENT: TOWER PEDESTAL DETAILS SHEET 2	STRUCTURAL
S2910	NJ ABUTMENT: TOWER PEDESTAL DETAILS SHEET 3	STRUCTURAL
S2911	NY ABUTMENT TOWER PLAN VIEWS	STRUCTURAL
S2912	NY ABUTMENT TOWER ELEVATION AND SECTION	STRUCTURAL
S2913	NY ABUTMENT TOWER ELEVATIONS	STRUCTURAL
S2914	NJ ABUTMENT TOWER PLAN VIEWS	STRUCTURAL
S2915	NJ ABUTMENT TOWER ELEVATION AND SECTION	STRUCTURAL
S2916	NJ ABUTMENT TOWER ELEVATIONS	STRUCTURAL
S2917	ABUTMENT TOWER ELECTRICAL/ELECTRONICS ROOM FLOOR DETAILS	STRUCTURAL
S2918	ABUTMENT TOWER: DRAINAGE PIPE DETAILS	STRUCTURAL
S2919	ABUTMENT TOWER: MEMBER DETAILS - SHEET 1	STRUCTURAL
S2920	ABUTMENT TOWER: MEMBER DETAILS - SHEET 2	STRUCTURAL

S2921	ABUTMENT TOWER: MEMBER DETAILS - SHEET 3	STRUCTURAL
S2922	ABUTMENT TOWER: MEMBER DETAILS - SHEET 4	STRUCTURAL
S2923	ABUTMENT TOWER: MEMBER DETAILS - SHEET 5	STRUCTURAL
S2924	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 1	STRUCTURAL
S2925	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 2	STRUCTURAL
S2926	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 3	STRUCTURAL
S2927	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 4	STRUCTURAL
S2928	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 5	STRUCTURAL
S2929	ABUTMENT TOWER: CONNECTION DETAILS - SHEET 6	STRUCTURAL
S2930	ABUTMENT TOWER: STEEL DETAILS - SHEET 1	STRUCTURAL
S2931	ABUTMENT TOWER: STEEL DETAILS - SHEET 2	STRUCTURAL
S2932	ABUTMENT TOWER: STEEL DETAILS - SHEET 3	STRUCTURAL
S2933	ABUTMENT TOWER: STEEL DETAILS - SHEET 4	STRUCTURAL
S2934	ABUTMENT TOWER: STEEL DETAILS - SHEET 5	STRUCTURAL
S2935	ABUTMENT TOWER: STEEL DETAILS - SHEET 6	STRUCTURAL
S2936	ABUTMENT TOWER: STEEL DETAILS - SHEET 7	STRUCTURAL
S2937	ABUTMENT TOWER: STEEL DETAILS - SHEET 8	STRUCTURAL
S2938	ABUTMENT TOWER: STEEL DETAILS - SHEET 9	STRUCTURAL
S2939	ABUTMENT TOWER: STEEL DETAILS - SHEET 10	STRUCTURAL
S2940	ABUTMENT TOWER: STAIR DETAILS - SHEET 1	STRUCTURAL
S2941	ABUTMENT TOWER: STAIR DETAILS - SHEET 2	STRUCTURAL
S2942	ABUTMENT TOWER: STAIR DETAILS - SHEET 3	STRUCTURAL
S2943	ABUTMENT TOWER: STAIR DETAILS - SHEET 4	STRUCTURAL
S2944	ABUTMENT TOWER: STAIR DETAILS - SHEET 5	STRUCTURAL
S2945	ABUTMENT TOWER: STAIR DETAILS - SHEET 6	STRUCTURAL
S2946	ABUTMENT TOWER: BEARING PLATE AND ANCHOR ROD DETAILS - SHEET 1	STRUCTURAL
S2947	ABUTMENT TOWER: BEARING PLATE AND ANCHOR ROD DETAILS - SHEET 2	STRUCTURAL
S3001	EXISTING ARCH MEMBERS KEY PLAN AND ELEVATION	STRUCTURAL
S3002	EXISTING ARCH PANEL POINT ELEVATIONS	STRUCTURAL
S3003	ARCH MEMBERS KEY PLAN AND ELEVATION	STRUCTURAL
S3004	UPPER CHORD MEMBER TABLE - SHEET 1	STRUCTURAL
S3005	UPPER CHORD MEMBER TABLE - SHEET 2	STRUCTURAL
S3006	LOWER CHORD MEMBER TABLE - SHEET 1	STRUCTURAL
S3007	LOWER CHORD MEMBER TABLE - SHEET 2	STRUCTURAL

S3008	VERTICAL MEMBER TABLE - SHEET 1	STRUCTURAL
S3009	VERTICAL MEMBER TABLE - SHEET 2	STRUCTURAL
S3010	DIAGONAL MEMBER TABLE - SHEET 1	STRUCTURAL
S3011	DIAGONAL MEMBER TABLE - SHEET 2	STRUCTURAL
S3012	UPPER CHORD STRUT MEMBER TABLE - SHEET 1	STRUCTURAL
S3013	UPPER CHORD STRUT MEMBER TABLE - SHEET 2	STRUCTURAL
S3014	LOWER CHORD STRUT MEMBER TABLE - SHEET 1	STRUCTURAL
S3015	LOWER CHORD STRUT MEMBER TABLE - SHEET 2	STRUCTURAL
S3016	UPPER CHORD DIAGONAL BRACING MEMBER TABLE - SHEET 1	STRUCTURAL
S3017	UPPER CHORD DIAGONAL BRACING MEMBER TABLE - SHEET 2	STRUCTURAL
S3018	LOWER CHORD DIAGONAL BRACING MEMBER TABLE - SHEET 1	STRUCTURAL
S3019	LOWER CHORD DIAGONAL BRACING MEMBER TABLE - SHEET 2	STRUCTURAL
S3020	SWAY BRACING AND POST MEMBER TABLE - SHEET 1	STRUCTURAL
S3021	SWAY BRACING AND POST MEMBER TABLE - SHEET 2	STRUCTURAL
S3022	EXISTING FLOORBEAM MEMBER TABLE - SHEET 1	STRUCTURAL
S3023	EXISTING FLOORBEAM MEMBER TABLE - SHEET 2	STRUCTURAL
S3024	UPPER CHORD FORCE TABLE - SHEET 1	STRUCTURAL
S3025	UPPER CHORD FORCE TABLE - SHEET 2	STRUCTURAL
S3026	LOWER CHORD FORCE TABLE - SHEET 1	STRUCTURAL
S3027	LOWER CHORD FORCE TABLE - SHEET 2	STRUCTURAL
S3028	VERTICAL FORCE TABLE - SHEET 1	STRUCTURAL
S3029	VERTICAL FORCE TABLE - SHEET 2	STRUCTURAL
S3030	DIAGONAL FORCE TABLE - SHEET 1	STRUCTURAL
S3031	DIAGONAL FORCE TABLE - SHEET 2	STRUCTURAL
S3032	UPPER CHORD STRUT FORCE TABLE - SHEET 1	STRUCTURAL
S3033	UPPER CHORD STRUT FORCE TABLE - SHEET 2	STRUCTURAL
S3034	LOWER CHORD STRUT FORCE TABLE - SHEET 1	STRUCTURAL
S3035	LOWER CHORD STRUT FORCE TABLE - SHEET 2	STRUCTURAL
S3036	UPPER CHORD DIAGONAL BRACING FORCE TABLE - SHEET 1	STRUCTURAL
S3037	UPPER CHORD DIAGONAL BRACING FORCE TABLE - SHEET 2	STRUCTURAL
S3038	LOWER CHORD DIAGONAL BRACING FORCE TABLE - SHEET 1	STRUCTURAL
S3039	LOWER CHORD DIAGONAL BRACING FORCE TABLE - SHEET 2	STRUCTURAL
S3040	SWAY BRACING AND POST MEMBER FORCE TABLE	STRUCTURAL

	- SHEET 1	
S3041	SWAY BRACING AND POST MEMBER FORCE TABLE - SHEET 2	STRUCTURAL
S3042	EXISTING FLOORBEAM MEMBER FORCE TABLE - SHEET 1	STRUCTURAL
S3043	EXISTING FLOORBEAM MEMBER FORCE TABLE - SHEET 2	STRUCTURAL
S3101	PANEL POINTS PP0-PP5 ELEVATIONS	STRUCTURAL
S3102	PANEL POINTS PP6-PP10 ELEVATIONS	STRUCTURAL
S3103	PANEL POINT 0 - SECTION	STRUCTURAL
S3104	PANEL POINT 0 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3105	PANEL POINT 0 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3106	PANEL POINT 0 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3107	PANEL POINT 1 - SECTION	STRUCTURAL
S3108	PANEL POINT 1 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3109	PANEL POINT 1 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3110	PANEL POINT 2 - SECTION	STRUCTURAL
S3111	PANEL POINT 2 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3112	PANEL POINT 2 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3113	PANEL POINT 2 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3114	PANEL POINT 3 - SECTION	STRUCTURAL
S3115	PANEL POINT 3 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3116	PANEL POINT 3 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3117	PANEL POINT 3 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3118	PANEL POINT 3 - SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3119	PANEL POINT 4 - SECTION	STRUCTURAL
S3120	PANEL POINT 4 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3121	PANEL POINT 4 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3122	PANEL POINT 5 - SECTION	STRUCTURAL
S3123	PANEL POINT 5 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3124	PANEL POINT 5 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3125	PANEL POINT 5 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3126	PANEL POINT 6 - SECTIONS	STRUCTURAL
S3127	PANEL POINT 6 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3128	PANEL POINT 6 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3129	PANEL POINT 6 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3130	PANEL POINT 6 - SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3131	PANEL POINT 6 - SECTIONS AND DETAILS - SHEET 5	STRUCTURAL
S3132	PANEL POINT 7 - SECTIONS	STRUCTURAL
S3133	PANEL POINT 7 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3134	PANEL POINT 7 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3135	PANEL POINT 7 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL

S3136	PANEL POINT 7 - SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3137	PANEL POINT 8 - SECTIONS	STRUCTURAL
S3138	PANEL POINT 8 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3139	PANEL POINT 8 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3140	PANEL POINT 8 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3141	PANEL POINT 8 - SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3142	PANEL POINT 9 - SECTIONS	STRUCTURAL
S3143	PANEL POINT 9 - SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3144	PANEL POINT 9 - SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3145	PANEL POINT 9 - SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3146	PANEL POINT 9 - SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3147	PANEL POINT 9 - SECTIONS AND DETAILS - SHEET 5	STRUCTURAL
S3148	PANEL POINT 10 PART PLAN, ELEVATION AND TYPICAL CROSS SECTIONS	STRUCTURAL
S3149	PANEL POINT 10 TYPICAL STRINGER CONNECTION DETAILS	STRUCTURAL
S3150	PANEL POINT 10 DETAILS SHEET 1	STRUCTURAL
S3151	PANEL POINT 10 DETAILS SHEET 2	STRUCTURAL
S3152	PANEL POINT 10 DETAILS SHEET 3	STRUCTURAL
S3153	PANEL POINT 10 DETAILS SHEET 4	STRUCTURAL
S3154	PANEL POINT 10 DETAILS SHEET 5	STRUCTURAL
S3155	PANEL POINT 10 DETAILS SHEET 6	STRUCTURAL
S3156	PANEL POINT 10 DETAILS SHEET 7	STRUCTURAL
S3157	FRAME MEMBERS TYPICAL SECTIONS - SHEET 1	STRUCTURAL
S3158	FRAME MEMBERS TYPICAL SECTIONS - SHEET 2	STRUCTURAL
S3159	FRAME MEMBERS TYPICAL SECTIONS - SHEET 3	STRUCTURAL
S3160	FRAME MEMBERS TYPICAL SECTIONS - SHEET 4	STRUCTURAL
S3161	FRAME MEMBERS MISCELLANEOUS DETAILS - SHEET 1	STRUCTURAL
S3162	FRAME MEMBERS MISCELLANEOUS DETAILS - SHEET 2	STRUCTURAL
S3163	FRAME MEMBERS MISCELLANEOUS DETAILS - SHEET 3	STRUCTURAL
S3164	FRAME MEMBERS MISCELLANEOUS DETAILS - SHEET 4	STRUCTURAL
S3165	FRAME MEMBERS MISCELLANEOUS DETAILS - SHEET 5	STRUCTURAL
S3201	PORTAL FRAMING PLAN AND ELEVATION	STRUCTURAL
S3202	PORTAL FRAMING SECTIONS	STRUCTURAL
S3203	UPPER CHORD PORTAL PLAN	STRUCTURAL
S3204	UPPER CHORD PORTAL DETAILS - SHEET 1	STRUCTURAL
S3205	UPPER CHORD PORTAL DETAILS - SHEET 2	STRUCTURAL

S3206	LOWER CHORD PORTAL PLAN	STRUCTURAL
S3207	LOWER CHORD PORTAL DETAILS - SHEET 1	STRUCTURAL
S3208	LOWER CHORD PORTAL DETAILS - SHEET 2	STRUCTURAL
S3209	EXISTING PORTAL RE-FRAMING PLAN AND ELEVATION	STRUCTURAL
S3301	ARCH MEMBERS STRENGTHENING NOTES	STRUCTURAL
S3302	MEMBER STRENGTHENING PLAN AND ELEVATION	STRUCTURAL
S3303	BEARING SHOE STRENGTHENING AT L0 - ELEVATIONS AND SECTIONS	STRUCTURAL
S3304	BEARING SHOE STRENGTHENING AT L0 - SECTIONS AND DETAILS	STRUCTURAL
S3305	LOWER CHORD STRENGTHENING AT L0 - CONCRETE DETAILS	STRUCTURAL
S3306	LOWER CHORD STRENGTHENING AT L0 SOUTH - ELEVATION AND SECTIONS	STRUCTURAL
S3307	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 WATERSIDE-SOUTH-SHEET 1	STRUCTURAL
S3308	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 WATERSIDE-SOUTH-SHEET 2	STRUCTURAL
S3309	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 WATERSIDE-SOUTH-SHEET 3	STRUCTURAL
S3310	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 ROADSIDE-SOUTH-SHEET 1	STRUCTURAL
S3311	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 ROADSIDE-SOUTH-SHEET 2	STRUCTURAL
S3312	STRENGTHENING VERTICALS, DIAGONALS AND GUSSET PLATES AT PP0 TO PP3 ROADSIDE-SOUTH-SHEET 3	STRUCTURAL
S3313	EXISTING ELEVATION AT PP0 TO PP2 WATERSIDE - NORTH	STRUCTURAL
S3314	EXISTING AND REMOVAL PLAN AND ELEVATION AT PP0 TO PP2 - NORTH	STRUCTURAL
S3315	MODIFICATIONS PLAN AND ELEVATION AT PP0 TO PP2 - NORTH	STRUCTURAL
S3316	STRENGTHENING DETAILS AT PP0 TO PP2 - NORTH	STRUCTURAL
S3317	STRENGTHENING AND MODIFICATIONS AT U0-L0 - NORTH	STRUCTURAL
S3318	STRENGTHENING SECTIONS AT PP0 TO PP2 - NORTH	STRUCTURAL
S3319	STRENGTHENING SECTIONS AND DETAILS AT PP0 TO PP3 - SHEET 1	STRUCTURAL

S3320	STRENGTHENING SECTIONS AND DETAILS AT PP0 TO PP3 - SHEET 2	STRUCTURAL
S3321	CHORD BRACING STRENGTHENING PP0 TO PP3 - SHEET 1	STRUCTURAL
S3322	CHORD BRACING STRENGTHENING PP0 TO PP3 - SHEET 2	STRUCTURAL
S3323	LOWER CHORD STRENGTHENING AT L1 SOUTH - ELEVATION	STRUCTURAL
S3324	LOWER CHORD STRENGTHENING AT L1 SOUTH - SECTIONS	STRUCTURAL
S3325	LOWER CHORD STRENGTHENING AT L2 SOUTH - ELEVATION	STRUCTURAL
S3326	LOWER CHORD STRENGTHENING AT L2 SOUTH - SECTIONS	STRUCTURAL
S3327	LOWER CHORD STRENGTHENING AT L3 - ELEVATION AND SECTIONS	STRUCTURAL
S3328	UPPER CHORD STRENGTHENING AT U6 - ELEVATION AND SECTIONS	STRUCTURAL
S3329	UPPER CHORD STRENGTHENING AT U7 - ELEVATION AND SECTIONS	STRUCTURAL
S3330	UPPER CHORD STRENGTHENING AT U8 - ELEVATION AND SECTIONS	STRUCTURAL
S3331	CHORD BRACING STRENGTHENING PP8 TO PP9 - SHEET 1	STRUCTURAL
S3332	CHORD BRACING STRENGTHENING PP8 TO PP9 - SHEET 2	STRUCTURAL
S3333	LOWER CHORD STRENGTHENING AT L9 - ELEVATION	STRUCTURAL
S3334	LOWER CHORD STRENGTHENING AT L9 - SECTIONS	STRUCTURAL
S3335	LOWER CHORD STRENGTHENING AT L10 - ELEVATION	STRUCTURAL
S3336	LOWER CHORD STRENGTHENING AT L10 - SECTIONS	STRUCTURAL
S3337	LOWER CHORD STRENGTHENING AT L11 - ELEVATION	STRUCTURAL
S3338	LOWER CHORD STRENGTHENING AT L11 - SECTIONS	STRUCTURAL
S3339	LOWER CHORD STRENGTHENING AT L18 - ELEVATION AND SECTIONS	STRUCTURAL
S3340	LOWER CHORD STRENGTHENING AT L19 - ELEVATION AND SECTIONS	STRUCTURAL
S3341	LOWER CHORD STRENGTHENING AT L20 - ELEVATION AND SECTIONS	STRUCTURAL
S3401	SUSPENDER TOP CONNECTION DETAILS - SHEET 1	STRUCTURAL
S3402	SUSPENDER TOP CONNECTION DETAILS - SHEET 2	STRUCTURAL

S3403	SUSPENDER ANCHOR DETAILS - SHEET 1	STRUCTURAL
S3404	SUSPENDER ANCHOR DETAILS - SHEET 2	STRUCTURAL
S3405	CABLE SUSPENDER SUMMARY	STRUCTURAL
S3406	SUSPENDER DETAILS	STRUCTURAL
S3501	ARCH DECK UPPER FRAMING PLAN	STRUCTURAL
S3502	ARCH DECK LOWER FRAMING PLAN	STRUCTURAL
S3503	FLOORBEAM ELEVATIONS PP1 THRU PP5	STRUCTURAL
S3504	FLOORBEAM DETAILS PP0 THRU PP5	STRUCTURAL
S3505	FLOORBEAM DETAILS PP6 THRU PP9	STRUCTURAL
S3506	FLOORBEAM PLAN AND ELEVATION PP11	STRUCTURAL
S3507	FLOORBEAM PLAN AND ELEVATION PP12 THRU PP20	STRUCTURAL
S3508	FLOORBEAM DETAILS PP11 THRU PP20	STRUCTURAL
S3509	FLOORBEAM TYPICAL SECTIONS - SHEET 1	STRUCTURAL
S3510	FLOORBEAM TYPICAL SECTIONS - SHEET 2	STRUCTURAL
S3511	FLOORBEAM SPLICE DETAILS	STRUCTURAL
S3512	WIND BRACING PP0 THRU PP5	STRUCTURAL
S3513	UPPER CHORD BRACING PP2THRU PP3 - DETAILS	STRUCTURAL
S3514	UPPER CHORD BRACING PP5 THRU PP6 - SHEET 1	STRUCTURAL
S3515	UPPER CHORD BRACING PP5 THRU PP6 - SHEET 2	STRUCTURAL
S3516	LOWER CHORD BRACING PP5 THRU PP7 SHEET 1	STRUCTURAL
S3517	LOWER CHORD BRACING PP5 THRU PP7 SHEET 2	STRUCTURAL
S3518	LOWER CHORD BRACING PP5 THRU PP7 SHEET 3	STRUCTURAL
S3519	CHORD BRACING PP8 THRU PP11 - SHEET 1	STRUCTURAL
S3520	CHORD BRACING PP8 THRU PP11 - SHEET 2	STRUCTURAL
S3521	WIND BRACING PP11 THRU PP20 SHEET 1	STRUCTURAL
S3522	WIND BRACING PP11 THRU PP20 SHEET 2	STRUCTURAL
S3523	STRINGER DETAILS - SHEET 1	STRUCTURAL
S3524	STRINGER DETAILS - SHEET 2	STRUCTURAL
S3525	STRINGER DETAILS - SHEET 3	STRUCTURAL
S3526	DIAPHRAGM DETAILS - SHEET 1	STRUCTURAL
S3527	DIAPHRAGM DETAILS - SHEET 2	STRUCTURAL
S3528	DIAPHRAGM DETAILS - SHEET 3	STRUCTURAL
S3529	EAST EDGE GIRDER ELEVATION	STRUCTURAL
S3530	WEST EDGE GIRDER ELEVATION	STRUCTURAL
S3531	EDGE GIRDER DETAILS SHEET 1	STRUCTURAL
S3532	EDGE GIRDER DETAILS SHEET 2	STRUCTURAL
S3533	EDGE GIRDER DETAILS SHEET 3	STRUCTURAL
S3534	EDGE GIRDER DETAILS SHEET 4	STRUCTURAL
S3535	EDGE GIRDER DETAILS SHEET 5	STRUCTURAL
S3536	EDGE GIRDER DETAILS SHEET 6	STRUCTURAL

S3537	EDGE GIRDER TYPICAL SECTIONS	STRUCTURAL
S3538	WEST UTILITY CATWALK DETAILS	STRUCTURAL
S3539	CAMBER TABLES - SHEET 1	STRUCTURAL
S3540	CAMBER TABLES - SHEET 2	STRUCTURAL
S3541	HAUNCH TABLES - FLOORBEAMS - SHEET 1	STRUCTURAL
S3542	HAUNCH TABLES - FLOORBEAMS - SHEET 2	STRUCTURAL
S3543	HAUNCH TABLES - STRINGERS AND EDGE GIRDERS - SHEET 1	STRUCTURAL
S3544	HAUNCH TABLES - STRINGERS AND EDGE GIRDERS - SHEET 2	STRUCTURAL
S3545	HAUNCH TABLES - STRINGERS AND EDGE GIRDERS - SHEET 3	STRUCTURAL
S3546	HAUNCH TABLES - STRINGERS AND EDGE GIRDERS - SHEET 4	STRUCTURAL
S3601	ARCH DECK PLAN	STRUCTURAL
S3602	ARCH DECK SECTION AND DETAILS	STRUCTURAL
S3603	WEST UTILITY CATWALK PLAN	STRUCTURAL
S3604	WEST UTILITY CATWALK - TOWER TO PP5	STRUCTURAL
S3605	WEST UTILITY CATWALK - PP6 TO PP8	STRUCTURAL
S3606	WEST UTILITY CATWALK - PP9 TO PP20	STRUCTURAL
S3607	WEST UTILITY CATWALK - EXPANSION JOINT DETAILS	STRUCTURAL
S3608	WEST UTILITY CATWALK - TYPICAL DETAILS	STRUCTURAL
S3609	DECK REINFORCING PLAN - SHEET 1	STRUCTURAL
S3610	DECK REINFORCING PLAN - SHEET 2	STRUCTURAL
S3611	DECK REINFORCING PLAN - SHEET 3	STRUCTURAL
S3612	DECK REINFORCING PLAN - SHEET 4	STRUCTURAL
S3613	DECK REINFORCING SECTION	STRUCTURAL
S3614	BARRIER REINFORCING & CONSTRUCTION JOINT SECTIONS AND DETAILS	STRUCTURAL
S3615	CONCRETE BARRIER AND RAILING ELEVATIONS - SHEET 1	STRUCTURAL
S3616	CONCRETE BARRIER AND RAILING ELEVATIONS - SHEET 2	STRUCTURAL
S3617	CONCRETE MEDIAN BARRIER ELEVATION	STRUCTURAL
S3618	CONCRETE BARRIER RAILING DETAILS	STRUCTURAL
S3701	SHARED USE PATH AND SUP UTILITY CATWALK FRAMING PLAN & ELEVATION	STRUCTURAL
S3702	SHARED USE PATH AND SUP UTILITY CATWALK TYPICAL SECTION	STRUCTURAL
S3703	HALF FILLED GRID DECK AND CURB DETAILS - SHEET 1	STRUCTURAL
S3704	HALF FILLED GRID DECK AND CURB DETAILS -	STRUCTURAL

	SHEET 2	
S3705	HALF FILLED GRID DECK AND CURB DETAILS - SHEET 3	STRUCTURAL
S3706	HALF FILLED GRID DECK AND CURB DETAILS - SHEET 4	STRUCTURAL
S3707	SUP UTILITY CATWALK STEEL FRAMING AND CONNECTION DETAILS - SHEET 1	STRUCTURAL
S3708	SUP UTILITY CATWALK STEEL FRAMING AND CONNECTION DETAILS - SHEET 2	STRUCTURAL
S3709	SUP UTILITY CATWALK STEEL FRAMING AND CONNECTION DETAILS - SHEET 3	STRUCTURAL
S3710	SUP UTILITY CATWALK STEEL FRAMING AND CONNECTION DETAILS - SHEET 4	STRUCTURAL
S3711	FIRE STANDPIPE EAST CATWALK SUPPORT DETAILS - SHEET 1	STRUCTURAL
S3712	FIRE STANDPIPE EAST CATWALK SUPPORT DETAILS - SHEET 2	STRUCTURAL
S3713	FIRE STANDPIPE EAST CATWALK SUPPORT DETAILS - SHEET 3	STRUCTURAL
S3714	SHARED USE PATH SCUPPER DETAILS	STRUCTURAL
S3801	TOWER TRANSITION SPAN - FRAMING PLAN AND SECTIONS - SHEET 1	STRUCTURAL
S3802	TOWER TRANSITION SPAN - FRAMING PLAN AND SECTIONS - SHEET 2	STRUCTURAL
S3803	TOWER TRANSITION SPAN - DECK PLAN AND SECTIONS	STRUCTURAL
S3804	TOWER TRANSITION SPAN - DECK DETAILS - SHEET 1	STRUCTURAL
S3805	TOWER TRANSITION SPAN - DECK DETAILS - SHEET 2	STRUCTURAL
S3806	TOWER TRANSITION SPAN - FLOORBEAM AND SECTIONS	STRUCTURAL
S3807	TOWER TRANSITION SPAN - STRINGER AND DIAPHRAGM CONNECTIONS	STRUCTURAL
S3808	TOWER TRANSITION SPAN - STEEL DETAILS - SHEET 1	STRUCTURAL
S3809	TOWER TRANSITION SPAN - STEEL DETAILS - SHEET 2	STRUCTURAL
S3810	TOWER TRANSITION SPAN - BEARING DETAILS	STRUCTURAL
S3901	EXPANSION JOINT AT PANEL PP10 SOUTH	STRUCTURAL
S3902	EXPANSION JOINT AT PANEL PP10 NORTH	STRUCTURAL
S3903	EXPANSION JOINT AT SOUTH TOWER	STRUCTURAL
S3904	EXPANSION JOINT AT NORTH TOWER	STRUCTURAL
S3905	EXPANSION JOINT SECTIONS AND DETAILS - SHEET 1	STRUCTURAL

S3906	EXPANSION JOINT SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3907	EXPANSION JOINT SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3908	EXPANSION JOINT SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S3909	DRAINAGE LAYOUT, SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S3910	DRAINAGE LAYOUT, SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S3911	DRAINAGE LAYOUT, SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S3912	DRAINAGE SCUPPER DETAILS	STRUCTURAL
S3913	UPPER AND LOWER CHORD HANDRAIL DETAILS	STRUCTURAL
S3914	NAVIGATION LIGHTS SECTIONS LAYOUT AND DETAILS - SHEET 1	STRUCTURAL
S3915	NAVIGATION LIGHTS SECTIONS LAYOUT AND DETAILS - SHEET 2	STRUCTURAL
S3916	NAVIGATION LIGHTS SECTIONS LAYOUT AND DETAILS - SHEET 3	STRUCTURAL
S3917	AVIATION LIGHT TEMPORARY LOCATION SUPPORT DETAILS	STRUCTURAL
S3918	AVIATION LIGHT SUPPORT DETAILS	STRUCTURAL
S4001	MAIN SPAN FRAMING REPAIR PLAN - SHEET 1	STRUCTURAL
S4002	MAIN SPAN FRAMING REPAIR PLAN - SHEET 2	STRUCTURAL
S4003	MAIN SPAN FRAMING REPAIR PLAN - SHEET 3	STRUCTURAL
S4004	MAIN SPAN FRAMING REPAIR PLAN - SHEET 4	STRUCTURAL
S4005	MAIN SPAN FRAMING REPAIR PLAN - SHEET 5	STRUCTURAL
S4006	MAIN SPAN EAST ELEVATION - SHEET 1	STRUCTURAL
S4007	MAIN SPAN EAST ELEVATION - SHEET 2	STRUCTURAL
S4008	MAIN SPAN WEST ELEVATION - SHEET 1	STRUCTURAL
S4009	MAIN SPAN WEST ELEVATION - SHEET 2	STRUCTURAL
S4010	MAIN SPAN SOUTH SWAY FRAME ELEVATIONS	STRUCTURAL
S4011	MAIN SPAN NORTH SWAY FRAME ELEVATIONS	STRUCTURAL
S4012	REPAIR A1 - RIVET REMOVAL AND REPLACEMENT DETAILS	STRUCTURAL
S4013	REPAIR A2 - PACK RUST REMOVAL AND REPAIR DETAILS	STRUCTURAL
S4014	REPAIR A3 - LACED MEMBER REPAIR DETAILS	STRUCTURAL
S4015	REPAIR A4 - ACCESS MANHOLE REPAIR DETAILS	STRUCTURAL
S4016	REPAIR GR1 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4017	REPAIR GR2 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL

S4018	REPAIR GR3 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4019	REPAIR GR4 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4020	REPAIR GR5 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4021	REPAIR GR6 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4022	REPAIR GR7 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4023	REPAIR GR8 - LATERAL GUSSET PLATE REPAIR DETAILS	STRUCTURAL
S4024	MISCELLANEOUS REPAIR DETAILS - SHEET 1	STRUCTURAL
S4025	MISCELLANEOUS REPAIR DETAILS - SHEET 2	STRUCTURAL
S4026	UPPER AND LOWER CHORD MEMBER ACCESS MANHOLE LOCATIONS	STRUCTURAL
S4027	NEW YORK ABUTMENT CONCRETE REPAIRPLAN, ELEVATION AND SECTIONS	STRUCTURAL
S4028	NEW JERSEY ABUTMENT CONCRETE REPAIR PLAN AND ELEVATION	STRUCTURAL
S4029	TYPICAL CONCRETE REPAIR DETAILS	STRUCTURAL
S4030	NJ ABUTMENT P/T REPAIR DETAILS	STRUCTURAL
S4031	NJ ABUTMENT P/T CAP REPLACEMENT DETAILS	STRUCTURAL
S4032	SMART BRIDGE – GENERAL NOTES	STRUCTURAL
S4033	SMART BRIDGE – INSTRUMENTATION PLAN - VW GAGES	STRUCTURAL
S4034	SMART BRIDGE – INSTRUMENTATION PLAN - HS GAGES	STRUCTURAL
S4035	SMART BRIDGE – INSTRUMENTATION PLAN - BRIDGE MOVEMENT SENSORS	STRUCTURAL
S4036	SMART BRIDGE – TYPICAL DATA ACQUISITION DESIGN	STRUCTURAL
S4037	SMART BRIDGE – POWER AND NETWORK CABLE DESIGN	STRUCTURAL
S4038	SMART BRIDGE – CONNECTION DETAILS	STRUCTURAL
S4039	SMART BRIDGE – WEATHER SENSOR LOCATIONS	STRUCTURAL
S4101	CONSTRUCTION SEQUENCE - SHEET 1	STRUCTURAL
S4102	CONSTRUCTION SEQUENCE - SHEET 2	STRUCTURAL
S4103	CONSTRUCTION SEQUENCE - SHEET 3	STRUCTURAL
S4104	CONSTRUCTION SEQUENCE - SHEET 4	STRUCTURAL
S4105	CONSTRUCTION SEQUENCE - SHEET 5	STRUCTURAL
S4106	ABUTMENT TOWER: CONSTRUCTION STAGING DETAILS - STAGE 1	STRUCTURAL
S4107	ABUTMENT TOWER: CONSTRUCTION STAGING	STRUCTURAL

	DETAILS - STAGE 2	
S4108	ABUTMENT TOWER: CONSTRUCTION STAGING DETAILS - STAGE 3, 4 AND 5	STRUCTURAL
S4109	CONSTRUCTION STAGING DETAILS PP0 AND PP1	STRUCTURAL
S4110	CONSTRUCTION STAGING DETAILS PP2	STRUCTURAL
S4111	CONSTRUCTION STAGING DETAILS PP3	STRUCTURAL
S4112	CONSTRUCTION STAGING DETAILS PP4	STRUCTURAL
S4113	CONSTRUCTION STAGING DETAILS PP5	STRUCTURAL
S4114	CONSTRUCTION STAGING DETAILS PP6	STRUCTURAL
S4115	CONSTRUCTION STAGING DETAILS PP7	STRUCTURAL
S4116	CONSTRUCTION STAGING DETAILS PP8	STRUCTURAL
S4117	CONSTRUCTION STAGING DETAILS PP9	STRUCTURAL
S4118	CONSTRUCTION STAGING DETAILS PP10	STRUCTURAL
S4119	CONSTRUCTION STAGING DETAILS PP11S-PP11N STAGES 1 AND 2	STRUCTURAL
S4120	CONSTRUCTION STAGING DETAILS PP11S-PP11N STAGE 3	STRUCTURAL
S4121	CONSTRUCTION STAGING DETAILS PP11S-PP11N STAGES 4 AND 5	STRUCTURAL
S4122	INSTALLATION OF SUSPENDERS - SHEET 1	STRUCTURAL
S4123	INSTALLATION OF SUSPENDERS - SHEET 2	STRUCTURAL
S4124	PORTAL CONSTRUCTION SEQUENCE	STRUCTURAL
S4125	TEMPORARY BRACING PLANS AND SEQUENCE PP0-PP5	STRUCTURAL
S4126	TEMPORARY BRACING DETAILS PP0-PP3	STRUCTURAL
S4127	TEMPORARY BRACING DETAILS - SHEET 1	STRUCTURAL
S4128	TEMPORARY BRACING DETAILS - SHEET 2	STRUCTURAL
S4129	TEMPORARY BRACING DETAILS - SHEET 3	STRUCTURAL
S4130	TEMPORARY BRACING DETAILS - SHEET 4	STRUCTURAL
S4131	EXISTING PORTAL RE-FRAMING CONSTRUCTION SEQUENCE	STRUCTURAL
S4132	REMOVAL OF NON-SUSPENDED FLOOR SCHEMATICS	STRUCTURAL
S4133	REMOVAL OF SUSPENDED FLOOR SCHEMATICS	STRUCTURAL
S4134	ERECTION DERRICK SCHEMATICS	STRUCTURAL
S4135	DEMOLITON PLAN AND ELEVATION	STRUCTURAL
S4136	DEMOLITON SECTIONS	STRUCTURAL
S4137	EXISTING ARCH LEAD ABATEMENT WORK	STRUCTURAL
S4201	ARCH SUPPLEMENTAL DETAILS KEY PLAN AND ELEVATION	STRUCTURAL
S4202	ARCH LOWER CHORD SUPPLEMENTAL PLATES GENERAL ELEVATION & ERECTION SEQUENCE	STRUCTURAL
S4203	ARCH LOWER CHORD SUPPLEMENTAL PLATES L8-	STRUCTURAL

	L9 ELEVATIONS STEP 1	
S4204	ARCH LOWER CHORD SUPPLEMENTAL PLATES L8-L9 TOP & BOT. VIEWS STEP 1	STRUCTURAL
S4205	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 ELEVATIONS STEP 1	STRUCTURAL
S4206	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 TOP & BOT. VIEWS STEP 1	STRUCTURAL
S4207	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 ELEVATIONS STEP 1	STRUCTURAL
S4208	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 TOP & BOT. VIEWS STEP 1	STRUCTURAL
S4209	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 ELEVATIONS STEP 1	STRUCTURAL
S4210	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 TOP & BOT. VIEWS STEP 1	STRUCTURAL
S4211	ARCH LOWER CHORD SUPPLEMENTAL PLATES L12-L13 ELEVATIONS STEP 1	STRUCTURAL
S4212	ARCH LOWER CHORD SUPPLEMENTAL PLATES L12-L13 TOP & BOT. VIEWS STEP 1	STRUCTURAL
S4213	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 1 SECTIONS - SHEET 1	STRUCTURAL
S4214	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 1 SECTIONS - SHEET 2	STRUCTURAL
S4215	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 1 SECTIONS - SHEET 3	STRUCTURAL
S4216	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 1 SECTIONS - SHEET 4	STRUCTURAL
S4217	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 1 SECTIONS - SHEET 5	STRUCTURAL
S4218	ARCH LOWER CHORD SUPPLEMENTAL PLATES L8-L9 ELEVATIONS STEP 2	STRUCTURAL
S4219	ARCH LOWER CHORD SUPPLEMENTAL PLATES L8-L9 TOP & BOT. VIEWS STEP 2	STRUCTURAL
S4220	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 ELEVATIONS STEP 2	STRUCTURAL
S4221	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 TOP & BOT. VIEWS STEP 2	STRUCTURAL
S4222	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 ELEVATIONS STEP 2	STRUCTURAL
S4223	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 TOP & BOT. VIEWS STEP 2	STRUCTURAL
S4224	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 ELEVATIONS STEP 2	STRUCTURAL
S4225	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 TOP & BOT. VIEWS STEP 2	STRUCTURAL

S4226	ARCH LOWER CHORD SUPPLEMENTAL PLATES L12-L13 ELEVATIONS STEP 2	STRUCTURAL
S4227	ARCH LOWER CHORD SUPPLEMENTAL PLATES L12-L13 TOP & BOT. VIEWS STEP 2	STRUCTURAL
S4228	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 2 SECTIONS - SHEET 1	STRUCTURAL
S4229	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 2 SECTIONS - SHEET 2	STRUCTURAL
S4230	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 2 SECTIONS - SHEET 3	STRUCTURAL
S4231	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 2 SECTIONS - SHEET 4	STRUCTURAL
S4232	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 2 SECTIONS - SHEET 5	STRUCTURAL
S4233	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 ELEVATIONS STEP 3	STRUCTURAL
S4234	ARCH LOWER CHORD SUPPLEMENTAL PLATES L9-L10 TOP & BOT. VIEWS STEP 3	STRUCTURAL
S4235	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 ELEVATIONS STEP 3	STRUCTURAL
S4236	ARCH LOWER CHORD SUPPLEMENTAL PLATES L10-L11 TOP & BOT. VIEWS STEP 3	STRUCTURAL
S4237	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 ELEVATIONS STEP 3	STRUCTURAL
S4238	ARCH LOWER CHORD SUPPLEMENTAL PLATES L11-L12 TOP & BOT. VIEWS STEP 3	STRUCTURAL
S4239	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 3 SECTIONS - SHEET 1	STRUCTURAL
S4240	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 3 SECTIONS - SHEET 2	STRUCTURAL
S4241	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 3 SECTIONS - SHEET 3	STRUCTURAL
S4242	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 3 SECTIONS - SHEET 4	STRUCTURAL
S4243	ARCH LOWER CHORD SUPPLEMENTAL PLATES STEP 3 SECTIONS - SHEET 5	STRUCTURAL
S4244	ARCH LOWER CHORD SUPPLEMENTAL PLATES MISC. SECTIONS & DETAILS - SHEET 1	STRUCTURAL
S4245	ARCH LOWER CHORD SUPPLEMENTAL PLATES MISC. SECTIONS & DETAILS - SHEET 2	STRUCTURAL
S4246	ARCH CHORD GATE ELEVATION	STRUCTURAL
S4247	ARCH CHORD GATE AT UPPER CHORD SECTIONS	STRUCTURAL
S4248	ARCH CHORD GATE AT LOWER CHORD SECTIONS - SHEET 1	STRUCTURAL
S4249	ARCH CHORD GATE AT LOWER CHORD SECTIONS -	STRUCTURAL

	SHEET 2	
S4250	ARCH CHORD GATE SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S4251	ARCH CHORD GATE SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S4252	ARCH CHORD GATE SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S4253	ACCESS FENCE AT ARCH NEW YORK ABUTMENT PLAN AND ELEVATIONS	STRUCTURAL
S4254	ACCESS FENCE AT ARCH NEW JERSEY ABUTMENT PLAN AND ELEVATIONS	STRUCTURAL
S4255	ACCESS FENCE AT ARCH ABUTMENT SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S4256	ACCESS FENCE AT ARCH ABUTMENT SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S4257	ACCESS FENCE AT ARCH ABUTMENT SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S4258	ARCH CHORD INTUMESCENT PAINT LIMIT	STRUCTURAL
S4301	BUILDING STRUCTURAL NOTES	STRUCTURAL
S4302	NY ELECTRICAL/MECHANICAL BUILDING FOUNDATION PLAN	STRUCTURAL
S4303	NJ ELECTRICAL/MECHANICAL BUILDING FOUNDATION PLAN	STRUCTURAL
S4304	NY STORAGE BUILDING FOUNDATION PLAN	STRUCTURAL
S4305	NY SALT SHED FOUNDATION PLAN	STRUCTURAL
S4306	NY ELECTRICAL/MECHANICAL BUILDING FRAMING PLAN	STRUCTURAL
S4307	NJ ELECTRICAL/MECHANICAL BUILDING FRAMING PLAN	STRUCTURAL
S4308	ELECTRICAL/MECHANICAL BUILDING FRAMING SECTIONS	STRUCTURAL
S4309	NY STORAGE BUILDING FRAMING PLAN	STRUCTURAL
S4310	TOWER BUILDING PLANS	STRUCTURAL
S4311	FOUNDATION SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S4312	FOUNDATION SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S4313	FOUNDATION SECTIONS AND DETAILS - SHEET 3	STRUCTURAL
S4314	CONCRETE SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S4315	CONCRETE SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S4316	MASONRY DETAILS - SHEET 1	STRUCTURAL
S4317	MASONRY SECTIONS AND DETAILS -SHEET 2	STRUCTURAL
S4318	FRAMING SECTIONS AND DETAILS - SHEET 1	STRUCTURAL
S4319	FRAMING SECTIONS AND DETAILS - SHEET 2	STRUCTURAL
S4320	FRAMING SECTIONS AND DETAILS - SHEET 3	STRUCTURAL

S4321	FRAMING SECTIONS AND DETAILS - SHEET 4	STRUCTURAL
S4322	MISCELLANEOUS DETAILS	STRUCTURAL
S4401	SUP RAILING ELEVATION AND POST DETAILS - SHEET 1	STRUCTURAL
S4402	SUP RAILING ELEVATION AND POST DETAILS - SHEET 2	STRUCTURAL
S4403	SUP RAILING ELEVATION AND POST DETAILS - SHEET 3	STRUCTURAL
S4404	SUP RAILING ELEVATION AND POST DETAILS - SHEET 4	STRUCTURAL
S4405	SUP RAILING ELEVATION AND POST DETAILS - SHEET 5	STRUCTURAL
S4406	RAILING ELEVATION AND POST DETAILS - SHEET 6	STRUCTURAL
S4407	RAILING ELEVATION AND POST DETAILS - SHEET 7	STRUCTURAL
S4408	SUP GATE ELEVATION AND CONNECTION DETAILS	STRUCTURAL
G0601	TITLE SHEET	GENERAL
GT0101	INSTRUMENTATION AND MONITORING GENERAL NOTES SHEET 1	GEOTECHNICAL
GT0102	INSTRUMENTATION AND MONITORING GENERAL NOTES SHEET 2	GEOTECHNICAL
GT0103	INSTRUMENTATION AND MONITORING PLANS SHEET 1	GEOTECHNICAL
GT0104	INSTRUMENTATION AND MONITORING PLANS SHEET 2	GEOTECHNICAL
GT0105	INSTRUMENTATION AND MONITORING PLANS SHEET 3	GEOTECHNICAL
GT0106	INSTRUMENTATION AND MONITORING PLANS SHEET 4	GEOTECHNICAL
GT0107	INSTRUMENTATION AND MONITORING PLANS SHEET 5	GEOTECHNICAL
GT0108	INSTRUMENTATION AND MONITORING PLANS SHEET 6	GEOTECHNICAL
GT0109	INSTRUMENTATION AND MONITORING PLANS SHEET 7	GEOTECHNICAL
GT0110	INSTRUMENTATION AND MONITORING PLANS SHEET 8	GEOTECHNICAL
GT0111	INSTRUMENTATION AND MONITORING PLANS SHEET 9	GEOTECHNICAL
GT0112	INSTRUMENTATION AND MONITORING PLANS SHEET 10	GEOTECHNICAL
GT0113	INSTRUMENTATION DETAILS SHEET 1	GEOTECHNICAL
GT0114	INSTRUMENTATION DETAILS SHEET 2	GEOTECHNICAL
MT0101	MAINTENANCE OF TRAFFIC LEGEND AND ABBREVIATIONS	TRAFFIC (MOT)

MT0102	MAINTENANCE OF TRAFFIC GENERAL NOTES	TRAFFIC (MOT)
MT0103	MAINTENANCE OF TRAFFIC - SEQUENCE OF CONSTRUCTION - SHEET 1	TRAFFIC (MOT)
MT0104	MAINTENANCE OF TRAFFIC - SEQUENCE OF CONSTRUCTION - SHEET 2	TRAFFIC (MOT)
MT0201	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 1	TRAFFIC (MOT)
MT0202	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 2	TRAFFIC (MOT)
MT0203	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 3	TRAFFIC (MOT)
MT0204	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 4	TRAFFIC (MOT)
MT0205	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 5	TRAFFIC (MOT)
MT0206	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 6	TRAFFIC (MOT)
MT0207	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 7	TRAFFIC (MOT)
MT0208	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 8	TRAFFIC (MOT)
MT0209	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 9	TRAFFIC (MOT)
MT0210	MAINTENANCE OF TRAFFIC: PLAN - STAGE 1 - SHEET 10	TRAFFIC (MOT)
MT0211	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 1	TRAFFIC (MOT)
MT0212	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 2	TRAFFIC (MOT)
MT0213	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 3	TRAFFIC (MOT)
MT0214	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 4	TRAFFIC (MOT)
MT0215	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 5	TRAFFIC (MOT)
MT0216	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 6	TRAFFIC (MOT)
MT0217	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 7	TRAFFIC (MOT)
MT0218	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 8	TRAFFIC (MOT)
MT0219	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 9	TRAFFIC (MOT)
MT0220	MAINTENANCE OF TRAFFIC: PLAN - STAGE 2 - SHEET 10	TRAFFIC (MOT)

MT0221	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 1	TRAFFIC (MOT)
MT0222	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 2	TRAFFIC (MOT)
MT0223	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 3	TRAFFIC (MOT)
MT0224	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 4	TRAFFIC (MOT)
MT0225	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 5	TRAFFIC (MOT)
MT0226	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 6	TRAFFIC (MOT)
MT0227	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 7	TRAFFIC (MOT)
MT0228	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 8	TRAFFIC (MOT)
MT0229	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 9	TRAFFIC (MOT)
MT0230	MAINTENANCE OF TRAFFIC: PLAN - STAGE 3 - SHEET 10	TRAFFIC (MOT)
MT0231	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 1	TRAFFIC (MOT)
MT0232	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 2	TRAFFIC (MOT)
MT0233	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 3	TRAFFIC (MOT)
MT0234	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 4	TRAFFIC (MOT)
MT0235	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 5	TRAFFIC (MOT)
MT0236	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 6	TRAFFIC (MOT)
MT0237	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 7	TRAFFIC (MOT)
MT0238	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 8	TRAFFIC (MOT)
MT0239	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 9	TRAFFIC (MOT)
MT0240	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4 - SHEET 10	TRAFFIC (MOT)
MT0241	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 1	TRAFFIC (MOT)
MT0242	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 2	TRAFFIC (MOT)
MT0243	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 -	TRAFFIC (MOT)

	SHEET 3	
MT0244	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 4	TRAFFIC (MOT)
MT0245	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 5	TRAFFIC (MOT)
MT0246	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 6	TRAFFIC (MOT)
MT0247	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 7	TRAFFIC (MOT)
MT0248	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 8	TRAFFIC (MOT)
MT0249	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 9	TRAFFIC (MOT)
MT0250	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5 - SHEET 10	TRAFFIC (MOT)
MT0251	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4B - SHEET 1	TRAFFIC (MOT)
MT0252	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4B - SHEET 2	TRAFFIC (MOT)
MT0253	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4C - SHEET 1	TRAFFIC (MOT)
MT0254	MAINTENANCE OF TRAFFIC: PLAN - STAGE 4C - SHEET 2	TRAFFIC (MOT)
MT0255	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5B - SHEET 1	TRAFFIC (MOT)
MT0256	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5B - SHEET 2	TRAFFIC (MOT)
MT0257	MAINTENANCE OF TRAFFIC: PLAN - STAGE 5B - SHEET 3	TRAFFIC (MOT)
MT0301	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS ON ARCH SPAN - SHEET 1	TRAFFIC (MOT)
MT0302	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS ON ARCH SPAN - SHEET 2	TRAFFIC (MOT)
MT0303	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS OF APPROACHES ON STRUCTURE- SHEET 1	TRAFFIC (MOT)
MT0304	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS OF APPROACHES ON STRUCTURE- SHEET 2	TRAFFIC (MOT)
MT0305	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS OF APPROACHES ON GRADE - SHEET 1	TRAFFIC (MOT)
MT0306	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS OF APPROACHES ON GRADE - SHEET 2	TRAFFIC (MOT)
MT0307	MAINTENANCE OF TRAFFIC: TYPICAL SECTIONS AT TOLL PLAZA	TRAFFIC (MOT)
MT0401	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF MORNINGSTAR ROAD ENTRANCE	TRAFFIC (MOT)

	RAMP STAGE 4 CONSTRUCTION	
MT0402	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF MORNINGSTAR ROAD ENTRANCE RAMP STAGE 4B CONSTRUCTION	TRAFFIC (MOT)
MT0403	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF MORNINGSTAR ROAD ENTRANCE RAMP STAGE 5 CONSTRUCTION	TRAFFIC (MOT)
MT0404	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF RICHMOND TERRACE RAMPS STAGES 2 & 3 CONSTRUCTION	TRAFFIC (MOT)
MT0405	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OFJFK BLVD EXIT RAMP STAGE 2 CONSTRUCTION	TRAFFIC (MOT)
MT0406	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF TOLL PLAZA - SHEET 1	TRAFFIC (MOT)
MT0407	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF TOLL PLAZA - SHEET 2	TRAFFIC (MOT)
MT0408	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF TOLL PLAZA - SHEET 3	TRAFFIC (MOT)
MT0409	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF EATON PLACE	TRAFFIC (MOT)
MT0410	MAINTENANCE OF TRAFFIC: DETAILED PLAN OF TEMPORARY CLOSURES	TRAFFIC (MOT)
MT0411	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF MARGARET STREET	TRAFFIC (MOT)
MT0412	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF NEWARK AVENUE - SHEET 1	TRAFFIC (MOT)
MT0413	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF NEWARK AVENUE - SHEET 2	TRAFFIC (MOT)
MT0414	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF NEWARK AVENUE - SHEET 3	TRAFFIC (MOT)
MT0415	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF CONSTRUCTION ACCESS ROADWAY - SHEET 1	TRAFFIC (MOT)
MT0416	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF CONSTRUCTION ACCESS ROADWAY - SHEET 2	TRAFFIC (MOT)
MT0417	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF RICHMOND TERRACE - SHEET 1	TRAFFIC (MOT)
MT0418	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF RICHMOND TERRACE - SHEET 2	TRAFFIC (MOT)
MT0419	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF RICHMOND TERRACE - SHEET 3	TRAFFIC (MOT)
MT0420	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND SECTIONS OF RICHMOND TERRACE - SHEET 4	TRAFFIC (MOT)
MT0421	MAINTENANCE OF TRAFFIC: DETAILED PLAN AND	TRAFFIC (MOT)

	SECTIONS OF RICHMOND TERRACE - SHEET 5	
MT0422	MAINTENANCE OF TRAFFIC: DETAILED PLAN OF LOCAL STREET PAVEMENT MARKING MODIFICATIONS	TRAFFIC (MOT)
MT0423	MAINTENANCE OF TRAFFIC: DETAILED PLANS OF LOCAL STREET UTILITY WORK AREAS	TRAFFIC (MOT)
MT0501	MAINTENANCE OF TRAFFIC: DETOUR PLAN SR. 440 SB EXIT RAMP TO MORNINGSTAR ROAD	TRAFFIC (MOT)
MT0502	MAINTENANCE OF TRAFFIC: DETOUR PLAN ENTRANCE AND EXIT RAMPS RICHMOND TERRACE - SHEET 1	TRAFFIC (MOT)
MT0503	MAINTENANCE OF TRAFFIC: DETOUR PLAN ENTRANCE AND EXIT RAMPS RICHMOND TERRACE - SHEET 2	TRAFFIC (MOT)
MT0504	MAINTENANCE OF TRAFFIC: DETOUR PLAN SR. 440 NB EXIT RAMP TO JFK BOULEVARD	TRAFFIC (MOT)
MT0505	MAINTENANCE OF TRAFFIC: DETOUR PLAN ENTRANCE RAMP FROM AVENUE A TO SR. 440 SB	TRAFFIC (MOT)
MT0506	MAINTENANCE OF TRAFFIC: DETOUR PLAN ENTRANCE RAMP FROM JFK BOULEVARD TO SR. 440 SB	TRAFFIC (MOT)
MT0507	MAINTENANCE OF TRAFFIC: DETOUR PLAN NEWARK AVENUE NB	TRAFFIC (MOT)
MT0508	MAINTENANCE OF TRAFFIC: DETOUR PLAN BAYONNE TEMPORARY LOCAL ROAD CLOSURES	TRAFFIC (MOT)
MT0509	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE/OVERSIZED VEHICLE SIGN LEGEND	TRAFFIC (MOT)
MT0510	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE NB NIGHTTIME AND WEEKENDS - SHEET 1	TRAFFIC (MOT)
MT0511	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE NB NIGHTTIME AND WEEKENDS - SHEET 2	TRAFFIC (MOT)
MT0512	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE SB NIGHTTIME AND WEEKENDS - SHEET 1	TRAFFIC (MOT)
MT0513	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE SB NIGHTTIME AND WEEKENDS - SHEET 2	TRAFFIC (MOT)
MT0514	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE NB TURNAROUND	TRAFFIC (MOT)
MT0515	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE NB PORTABLE VMS SIGN LOCATIONS	TRAFFIC (MOT)
MT0516	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL CLOSURE SB TURNAROUND	TRAFFIC (MOT)
MT0517	MAINTENANCE OF TRAFFIC: DETOUR PLAN FULL	TRAFFIC (MOT)

	CLOSURE SB PORTABLE VMS SIGN LOCATIONS	
MT0518	MAINTENANCE OF TRAFFIC: DETOUR PLAN PORTABLE VMS SIGN LOCATIONS	TRAFFIC (MOT)
MT0519	MAINTENANCE OF TRAFFIC: DETOUR PLAN PORTABLE VMS DISPLAY TABLE	TRAFFIC (MOT)
MT0520	MAINTENANCE OF TRAFFIC: TYPICAL LANE CLOSURE & EXIT RAMP DETAIL FOR NIGHTTIME & WEEKEND	TRAFFIC (MOT)
MT0521	MAINTENANCE OF TRAFFIC: DETOUR PLAN RICHMOND TERRACE NIGHTTIME CLOSURE STAGES 1, 4 & 5	TRAFFIC (MOT)
MT0522	MAINTENANCE OF TRAFFIC: DETOUR PLAN RICHMOND TERRACE NIGHTTIME CLOSURE STAGES 2 AND 3	TRAFFIC (MOT)
MT0523	MAINTENANCE OF TRAFFIC: DETOUR PLAN RICHMOND TERRACE NIGHTTIME CLOSURE TRUCKS	TRAFFIC (MOT)
MT0524	MAINTENANCE OF TRAFFIC: DETOUR PLAN NEWARK AVENUE NIGHTTIME CLOSURE	TRAFFIC (MOT)
MT0525	MAINTENANCE OF TRAFFIC: DETOUR PLAN INNIS STREET NIGHTTIME CLOSURE	TRAFFIC (MOT)
MT0601	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 1	TRAFFIC (MOT)
MT0602	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 2	TRAFFIC (MOT)
MT0603	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 3	TRAFFIC (MOT)
MT0604	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 4	TRAFFIC (MOT)
MT0605	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 5	TRAFFIC (MOT)
MT0606	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 6	TRAFFIC (MOT)
MT0607	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 7	TRAFFIC (MOT)
MT0608	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 8	TRAFFIC (MOT)
MT0609	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 9	TRAFFIC (MOT)
MT0610	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 10	TRAFFIC (MOT)
MT0611	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 11	TRAFFIC (MOT)
MT0612	MAINTENANCE OF TRAFFIC: STANDARD DETAILS - SHEET 12	TRAFFIC (MOT)
MT0613	MAINTENANCE OF TRAFFIC: STANDARD DETAILS -	TRAFFIC (MOT)

	SHEET 13	
MT0614	MAINTENANCE OF TRAFFIC: CONSTRUCTION SIGN STANDARD DETAILS - SHEET 1	TRAFFIC (MOT)
MT0615	MAINTENANCE OF TRAFFIC: CONSTRUCTION SIGN STANDARD DETAILS - SHEET 2	TRAFFIC (MOT)
MT0616	MAINTENANCE OF TRAFFIC: CONSTRUCTION SIGN STANDARD DETAILS - SHEET 3	TRAFFIC (MOT)
MT0617	MAINTENANCE OF TRAFFIC: CONSTRUCTION SIGN STANDARD DETAILS - SHEET 4	TRAFFIC (MOT)
T0101	TRAFFIC LEGEND AND ABBREVIATIONS	TRAFFIC (SIGNING & PAVEMENT)
T0102	GENERAL TRAFFIC NOTES - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0103	GENERAL TRAFFIC NOTES - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0104	TRAFFIC KEY PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0105	TRAFFIC KEY PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0201	SIGNING PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0202	SIGNING PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0203	SIGNING PLAN - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0204	SIGNING PLAN - SHEET 4	TRAFFIC (SIGNING & PAVEMENT)
T0205	SIGNING PLAN - SHEET 5	TRAFFIC (SIGNING & PAVEMENT)
T0206	SIGNING PLAN - SHEET 6	TRAFFIC (SIGNING & PAVEMENT)
T0207	SIGNING PLAN - SHEET 7	TRAFFIC (SIGNING & PAVEMENT)
T0208	SIGNING PLAN - SHEET 8	TRAFFIC (SIGNING & PAVEMENT)
T0209	SIGNING PLAN - SHEET 9	TRAFFIC (SIGNING & PAVEMENT)
T0210	SIGNING PLAN - SHEET 10	TRAFFIC (SIGNING & PAVEMENT)
T0211	SIGNING PLAN - SHEET 11	TRAFFIC (SIGNING & PAVEMENT)
T0212	SIGNING PLAN - SHEET 12	TRAFFIC (SIGNING & PAVEMENT)
T0213	SIGNING PLAN - SHEET 13	TRAFFIC (SIGNING & PAVEMENT)

T0301	SIGN STRUCTURE ELEVATIONS - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0302	SIGN STRUCTURE ELEVATIONS - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0303	SIGN STRUCTURE ELEVATIONS - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0304	SIGN DATA TABLE- SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0305	SIGN DATA TABLE- SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0306	SIGN DATA TABLE- SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0307	SIGN DATA TABLE- SHEET 4	TRAFFIC (SIGNING & PAVEMENT)
T0308	SIGN DATA TABLE- SHEET 5	TRAFFIC (SIGNING & PAVEMENT)
T0309	SIGN DATA TABLE- SHEET 6	TRAFFIC (SIGNING & PAVEMENT)
T0310	SIGN DATA TABLE- SHEET 7	TRAFFIC (SIGNING & PAVEMENT)
T0311	SIGN DATA TABLE- SHEET 8	TRAFFIC (SIGNING & PAVEMENT)
T0312	SIGN DATA TABLE- SHEET 9	TRAFFIC (SIGNING & PAVEMENT)
T0313	SIGN DATA TABLE- SHEET 10	TRAFFIC (SIGNING & PAVEMENT)
T0314	SIGN DATA TABLE- SHEET 11	TRAFFIC (SIGNING & PAVEMENT)
T0315	SIGN DATA TABLE- SHEET 12	TRAFFIC (SIGNING & PAVEMENT)
T0316	SIGN DATA TABLE- SHEET 13	TRAFFIC (SIGNING & PAVEMENT)
T0317	SIGN DATA TABLE- SHEET 14	TRAFFIC (SIGNING & PAVEMENT)
T0318	SIGN DATA TABLE- SHEET 15	TRAFFIC (SIGNING & PAVEMENT)
T0319	SIGN DATA TABLE- SHEET 16	TRAFFIC (SIGNING & PAVEMENT)
T0320	SIGN LAYOUT - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0321	SIGN LAYOUT - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0322	SIGN LAYOUT - SHEET 3.	TRAFFIC (SIGNING & PAVEMENT)
T0323	SIGN LAYOUT - SHEET 4	TRAFFIC (SIGNING &

		PAVEMENT)
T0324	SIGN LAYOUT - SHEET 5	TRAFFIC (SIGNING & PAVEMENT)
T0325	SIGN LAYOUT - SHEET 6	TRAFFIC (SIGNING & PAVEMENT)
T0326	SIGN LAYOUT - SHEET 7	TRAFFIC (SIGNING & PAVEMENT)
T0327	SIGN LAYOUT - SHEET 8	TRAFFIC (SIGNING & PAVEMENT)
T0401	PAVEMENT MARKING PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0402	PAVEMENT MARKING PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0403	PAVEMENT MARKING PLAN - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0404	PAVEMENT MARKING PLAN - SHEET 4	TRAFFIC (SIGNING & PAVEMENT)
T0405	PAVEMENT MARKING PLAN - SHEET 5	TRAFFIC (SIGNING & PAVEMENT)
T0406	PAVEMENT MARKING PLAN - SHEET 6	TRAFFIC (SIGNING & PAVEMENT)
T0407	PAVEMENT MARKING PLAN - SHEET 7	TRAFFIC (SIGNING & PAVEMENT)
T0408	PAVEMENT MARKING PLAN - SHEET 8	TRAFFIC (SIGNING & PAVEMENT)
T0409	PAVEMENT MARKING PLAN - SHEET 9	TRAFFIC (SIGNING & PAVEMENT)
T0410	PAVEMENT MARKING PLAN - SHEET 10	TRAFFIC (SIGNING & PAVEMENT)
T0411	PAVEMENT MARKING PLAN - SHEET 11	TRAFFIC (SIGNING & PAVEMENT)
T0412	PAVEMENT MARKING PLAN - SHEET 12	TRAFFIC (SIGNING & PAVEMENT)
T0413	PAVEMENT MARKING PLAN - SHEET 13	TRAFFIC (SIGNING & PAVEMENT)
T0501	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0502	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0503	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0504	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 4	TRAFFIC (SIGNING & PAVEMENT)
T0505	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 5	TRAFFIC (SIGNING & PAVEMENT)

T0506	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 6	TRAFFIC (SIGNING & PAVEMENT)
T0507	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 7	TRAFFIC (SIGNING & PAVEMENT)
T0508	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 8	TRAFFIC (SIGNING & PAVEMENT)
T0509	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 9	TRAFFIC (SIGNING & PAVEMENT)
T0510	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 10	TRAFFIC (SIGNING & PAVEMENT)
T0511	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 11	TRAFFIC (SIGNING & PAVEMENT)
T0512	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 12	TRAFFIC (SIGNING & PAVEMENT)
T0513	GUIDE RAIL AND CONCRETE BARRIER PLAN - SHEET 13	TRAFFIC (SIGNING & PAVEMENT)
T0514	GUIDE RAIL AND CONCRETE BARRIER ENLARGEMENT PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0515	GUIDE RAIL AND CONCRETE BARRIER ENLARGEMENT PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0516	GUIDE RAIL AND CONCRETE BARRIER ENLARGEMENT PLAN - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0517	NY RESTORATION TRAFFIC DETAIL PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0518	NY RESTORATION TRAFFIC DETAIL PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0519	NJ RESTORATION TRAFFIC DETAIL PLAN - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0520	NJ RESTORATION TRAFFIC DETAIL PLAN - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0601	DETAILS - BREAKAWAY SIGN SUPPORTS AND U-POST ASSEMBLY - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0602	DETAILS - BREAKAWAY SIGN SUPPORTS AND U-POST ASSEMBLY - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0603	DETAILS - BREAKAWAY SUPPORT SYSTEM FOR SIGN POST BREAK-FREE MODEL AS4-H	TRAFFIC (SIGNING & PAVEMENT)
T0604	DETAILS - SIGN MOUNTED ON SIDEWALK	TRAFFIC (SIGNING & PAVEMENT)
T0605	DETAILS - STANDARD SIGN ASSEMBLY - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0606	DETAILS - STANDARD SIGN ASSEMBLY - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0607	DETAILS - STANDARD SIGN ASSEMBLY - SHEET 3	TRAFFIC (SIGNING & PAVEMENT)
T0608	DETAILS - STANDARD HEIGHT AND LATERAL	TRAFFIC (SIGNING &

	LOCATION FOR TRAFFIC ASSEMBLY	PAVEMENT)
T0609	DETAILS - J-CHANNEL AND H-CHANNEL	TRAFFIC (SIGNING & PAVEMENT)
T0610	DETAILS - BUCKLESTRAP, CLAMP AND CLIP MOUNTING	TRAFFIC (SIGNING & PAVEMENT)
T0611	DETAILS - LARGE GUIDE SIGN ASSEMBLY	TRAFFIC (SIGNING & PAVEMENT)
T0612	DETAILS - MULTIPLE POST SIGN INSTALLATION	TRAFFIC (SIGNING & PAVEMENT)
T0613	DETAILS - SIGN PANEL DETAILS FOR GUIDE, INFORMATION, AND OTHER SIGNS	TRAFFIC (SIGNING & PAVEMENT)
T0614	DETAILS - BREAKAWAY BASE AND HINGE ASSEMBLY	TRAFFIC (SIGNING & PAVEMENT)
T0615	DETAILS - REFERENCE MARKER	TRAFFIC (SIGNING & PAVEMENT)
T0616	DETAILS - PAVEMENT MARKING - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0617	DETAILS - PAVEMENT MARKING - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0618	DETAILS - SIGNING & PAVEMENT MARKING NJ RESIDENT ENGINEER OFFICE	TRAFFIC (SIGNING & PAVEMENT)
T0619	DETAILS - PARKING LOT MARKINGS	TRAFFIC (SIGNING & PAVEMENT)
T0620	DETAILS - ACCESSIBLE PARKING FOR PEOPLE WITH DISABILITIES	TRAFFIC (SIGNING & PAVEMENT)
T0621	DETAILS - JFK BLVD EXIT RAMP INTERSECTION	TRAFFIC (SIGNING & PAVEMENT)
T0622	DETAILS - DURA-CURB AND DELINEATOR GUIDE POST	TRAFFIC (SIGNING & PAVEMENT)
T0623	DETAILS - DELINEATOR AND MOUNTING - SHEET 1	TRAFFIC (SIGNING & PAVEMENT)
T0624	DETAILS - DELINEATOR AND MOUNTING - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0625	DETAILS - REFLECTORIZED PAVEMENT MARKERS AND PLACEMENT	TRAFFIC (SIGNING & PAVEMENT)
T0626	DETAILS - QUADGUARD IMPACT ATTENUATORS WITH TENSION STRUT BACKUP	TRAFFIC (SIGNING & PAVEMENT)
T0627	DETAILS - CAT-350	TRAFFIC (SIGNING & PAVEMENT)
T0628	DETAILS - 24" X 41" CONCRETE BARRIER CURB	TRAFFIC (SIGNING & PAVEMENT)
T0629	DETAILS - VARIABLE WIDTH BARRIER	TRAFFIC (SIGNING & PAVEMENT)
T0630	DETAILS - CONCRETE BARRIER HALF SECTION SINGLE SLOPE	TRAFFIC (SIGNING & PAVEMENT)

T0631	DETAILS - BARRIER TRANSITION	TRAFFIC (SIGNING & PAVEMENT)
T0632	DETAILS - W-BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0633	DETAILS - DUAL FACED W-BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0634	DETAILS - ANCHORAGE UNITS FOR HEAVY POST BLOCKED OUT CORRUGATED BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0635	DETAILS - THRIE-BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0636	DETAILS - GUIDE RAIL AND ATTACHMENTS GENERAL NOTES AND RUB RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0637	DETAILS - GUIDE RAIL POST INSTALLATION	TRAFFIC (SIGNING & PAVEMENT)
T0638	DETAILS - W-BEAM GUIDE RAIL INSTALLATION LAYOUT	TRAFFIC (SIGNING & PAVEMENT)
T0639	DETAILS - W-BEAM MEDIAN GUIDE RAIL INSTALLATION LAYOUT	TRAFFIC (SIGNING & PAVEMENT)
T0640	DETAILS - W-BEAM GUIDE RAIL ANCHORAGE IN NEW JERSEY	TRAFFIC (SIGNING & PAVEMENT)
T0641	DETAILS - THRIE-BEAM & W-BEAM GUIDE RAIL TERMINAL CONNECTION & END SECTION	TRAFFIC (SIGNING & PAVEMENT)
T0642	DETAILS - PARALLEL TYPE GATING END TERMINALS IN NEW YORK	TRAFFIC (SIGNING & PAVEMENT)
T0643	DETAILS - FLARED AND TANGENT GUIDE RAIL TERMINAL IN NEW JERSEY	TRAFFIC (SIGNING & PAVEMENT)
T0644	DETAILS - TRANSITION BETWEEN SINGLE SLOPE CONCRETE BARRIER & W-BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0645	DETAILS - TRANSITION BETWEEN JERSEY SHAPE CONCRETE BARRIER & W-BEAM GUIDE RAIL	TRAFFIC (SIGNING & PAVEMENT)
T0646	DETAILS - F SHAPE HALF SECTION BARRIER & TRANSITION	TRAFFIC (SIGNING & PAVEMENT)
T0647	DETAILS - TRANSITION HPBO SINGLE SLOPE & F-SHAPED HALF SECTION	TRAFFIC (SIGNING & PAVEMENT)
T0648	DETAILS - F-SHAPED SECTIONS AND TRANSITION TO CONCRETE BARRIER	TRAFFIC (SIGNING & PAVEMENT)
T0649	DETAILS - JERSEY SHAPE HALF SECTION BARRIER & FENCING ON CONCRETE BARRIER	TRAFFIC (SIGNING & PAVEMENT)
T0650	DETAILS - BARRIER TRANSITION AT TOLL GANTRY	TRAFFIC (SIGNING & PAVEMENT)
T0651	DETAILS - NONVEGETATIVE SURFACE DETAILS FOR NEW YORK	TRAFFIC (SIGNING & PAVEMENT)
T0652	DETAILS - NONVEGETATIVE SURFACE DETAILS FOR NEW JERSEY	TRAFFIC (SIGNING & PAVEMENT)
T0653	MISCELLANEOUS TABLES - SHEET 1	TRAFFIC (SIGNING &

		PAVEMENT)
T0654	MISCELLANEOUS TABLES - SHEET 2	TRAFFIC (SIGNING & PAVEMENT)
T0701	ITS GENERAL NOTES, LEGEND AND ABBREVIATIONS	TRAFFIC (ITS)
T0702	ITS SIGNAGE COORDINATION OVERVIEW	TRAFFIC (ITS)
T0703	ITS SIGNAGE COORDINATION PLAN 1	TRAFFIC (ITS)
T0704	ITS SIGNAGE COORDINATION PLAN 2	TRAFFIC (ITS)
T0705	ITS SIGNAGE COORDINATION PLAN 3	TRAFFIC (ITS)
T0706	ITS SIGNAGE COORDINATION PLAN 4	TRAFFIC (ITS)
T0707	ITS SIGNAGE COORDINATION PLAN 5	TRAFFIC (ITS)
T0708	ITS SIGNAGE COORDINATION PLAN 6	TRAFFIC (ITS)
T0709	ITS SIGNAGE COORDINATION PLAN 7	TRAFFIC (ITS)
T0710	ITS SIGNAGE COORDINATION PLAN 8	TRAFFIC (ITS)
T0711	ITS SIGNAGE COORDINATION PLAN 9	TRAFFIC (ITS)
T0712	ITS SIGNAGE COORDINATION PLAN 10	TRAFFIC (ITS)
T0713	ITS SIGNAGE COORDINATION PLAN 11	TRAFFIC (ITS)
T0714	ITS SIGNAGE COORDINATION PLAN 12	TRAFFIC (ITS)
T0715	ITS SIGNAGE COORDINATION PLAN 13	TRAFFIC (ITS)
T0716	ITS EQUIPMENT LOCATION LEGEND	TRAFFIC (ITS)
T0717	ITS EQUIPMENT LEGEND	TRAFFIC (ITS)
T0718	ITS ROADWAY WEATHER BLOCK DIAGRAM	TRAFFIC (ITS)
T0719	ITS SIGN CONTROL CABINET DETAILS	TRAFFIC (ITS)
T0720	ITS SIGN MESSAGE SCENARIOS SHEET 1	TRAFFIC (ITS)
T0721	ITS SIGN MESSAGE SCENARIOS SHEET 2	TRAFFIC (ITS)
T0722	ITS FIBER OPTIC AND COMMUNICATION OVERVIEW DIAGRAM	TRAFFIC (ITS)
T0723	ITS SIGN CONTROL CIRCUITS SHEET 1	TRAFFIC (ITS)
T0724	ITS SIGN CONTROL CIRCUITS SHEET 2	TRAFFIC (ITS)
T0725	ITS EQUIPMENT MOUNTING DETAILS SHEET 1	TRAFFIC (ITS)
T0726	ITS EQUIPMENT MOUNTING DETAILS SHEET 2	TRAFFIC (ITS)
T0727	ITS ELECTRICAL POWER DISCONNECT	TRAFFIC (ITS)
T0728	ITS CABLE SCHEDULE	TRAFFIC (ITS)
T0729	ITS VMS DISPLAY LAYOUT SHEET 1	TRAFFIC (ITS)
T0730	ITS VMS DISPLAY LAYOUT SHEET 2	TRAFFIC (ITS)
T0731	ITS VMS DISPLAY LAYOUT SHEET 3	TRAFFIC (ITS)
T0801	TOLL SIGNAGE LOCATION PLAN - SHEET 1	TRAFFIC (ADVANCE TOLL SIGNING)
T0802	TOLL SIGNAGE LOCATION PLAN - SHEET 2	TRAFFIC (ADVANCE TOLL SIGNING)
T0803	TOLL SIGNAGE LOCATION PLAN - SHEET 3	TRAFFIC (ADVANCE TOLL SIGNING)

T0804	SIGN DATA TABLE - SHEET 1	TRAFFIC (ADVANCE TOLL SIGNING)
T0805	SIGN DATA TABLE - SHEET 2	TRAFFIC (ADVANCE TOLL SIGNING)
T0806	SIGN DATA TABLE - SHEET 3	TRAFFIC (ADVANCE TOLL SIGNING)
T0807	SIGN LAYOUT - SHEET 1	TRAFFIC (ADVANCE TOLL SIGNING)
T0808	SIGN LAYOUT - SHEET 2	TRAFFIC (ADVANCE TOLL SIGNING)
T0809	SIGN LAYOUT - SHEET 3	TRAFFIC (ADVANCE TOLL SIGNING)
T0810	SIGN LAYOUT - SHEET 4	TRAFFIC (ADVANCE TOLL SIGNING)
T0811	SIGN LAYOUT - SHEET 5	TRAFFIC (ADVANCE TOLL SIGNING)
T0812	SIGN LAYOUT - SHEET 6	TRAFFIC (ADVANCE TOLL SIGNING)
T0901	KEY PLAN LOCAL STREET - ITS	TRAFFIC (ADAPTIVE SIGNALS)
T0902	GENERAL NOTES	TRAFFIC (ADAPTIVE SIGNALS)
T0903	TABULATION OF QUANTITIES	TRAFFIC (ADAPTIVE SIGNALS)
T0904	FOREST AVENUE AT WILLOW ROAD EAST	TRAFFIC (ADAPTIVE SIGNALS)
T0905	PORT RICHMOND AVENUE AT WALKER STREET	TRAFFIC (ADAPTIVE SIGNALS)
T0906	TRANTOR PLACE AT WALKER STREET	TRAFFIC (ADAPTIVE SIGNALS)
T0907	MORNINGSTAR ROAD AT WALKER STREET	TRAFFIC (ADAPTIVE SIGNALS)
T0908	RICHMOND TERRACE AT MORNINGSTAR ROAD	TRAFFIC (ADAPTIVE SIGNALS)
T0909	TYPICAL MICROWAVE SENSOR MOUNTING DETAILS	TRAFFIC (ADAPTIVE SIGNALS)
T0910	TYPICAL WIRELESS ANTENNA MOUNTING DETAILS	TRAFFIC (ADAPTIVE SIGNALS)
CS0101	CONSTRUCTION STAGING STAGE 0 SHEET 1	CONSTRUCTION STAGING
CS0102	CONSTRUCTION STAGING STAGE 0 SHEET 2	CONSTRUCTION STAGING
CS0103	CONSTRUCTION STAGING STAGE 1 SHEET 1	CONSTRUCTION STAGING
CS0104	CONSTRUCTION STAGING STAGE 1 SHEET 2	CONSTRUCTION STAGING
CS0105	CONSTRUCTION STAGING STAGE 2 SHEET 1	CONSTRUCTION STAGING
CS0106	CONSTRUCTION STAGING STAGE 2 SHEET 2	CONSTRUCTION STAGING
CS0107	CONSTRUCTION STAGING STAGE 3 SHEET 1	CONSTRUCTION STAGING
CS0108	CONSTRUCTION STAGING STAGE 3 SHEET 2	CONSTRUCTION STAGING
CS0109	CONSTRUCTION STAGING STAGE 4 SHEET 1	CONSTRUCTION STAGING
CS0110	CONSTRUCTION STAGING STAGE 4 SHEET 2	CONSTRUCTION STAGING
CS0111	CONSTRUCTION STAGING STAGE 5 SHEET 1	CONSTRUCTION STAGING
CS0112	CONSTRUCTION STAGING STAGE 5 SHEET 2	CONSTRUCTION STAGING
G0701	TITLE SHEET	HDR
M0101	MECHANICAL LEGEND	MECHANICAL

M0201	HVAC PLAN NEW YORK MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0202	HVAC PLAN NEW YORK TOWER ELECTRICAL / ELECTRONICS ROOMS	MECHANICAL
M0203	GENERATOR ROOM NEW YORK MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0204	HVAC PLAN NEW JERSEY MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0205	HVAC PLAN NEW JERSEY TOWER ELECTRICAL / ELECTRONICS ROOMS	MECHANICAL
M0206	GENERATOR ROOM NEW JERSEY MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0207	ADMIN BASEMENT MECHANICAL PLAN	MECHANICAL
M0208	ADMIN ROOF MECHANICAL PLAN	MECHANICAL
M0209	HYDRONIC PIPING DEMOLITION PLAN	MECHANICAL
M0210	HVAC PLAN NEW YORK STORAGE BUILDING	MECHANICAL
M0401	HVAC DETAILS	MECHANICAL
M0402	HVAC DETAILS	MECHANICAL
M0501	TEMPERATURE CONTROL PLAN NEW YORK MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0502	TEMPERATURE CONTROL PLAN NEW YORK TOWER ELECTRICAL / ELECTRONICS ROOMS	MECHANICAL
M0503	HVAC SEQUENCE OF OPERATIONS NEW YORK MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0504	BAS SYSTEM ARCHITECTURE	MECHANICAL
M0505	TEMPERATURE CONTROL PLAN NEW JERSEY MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0506	TEMPERATURE CONTROL PLAN NEW JERSEY TOWER ELECTRICAL / ELECTRONICS ROOMS	MECHANICAL
M0507	HVAC SEQUENCE OF OPERATIONS NEW JERSEY MECHANICAL / ELECTRICAL BUILDING	MECHANICAL
M0601	MECHANICAL SCHEDULES	MECHANICAL
M0602	MECHANICAL SCHEDULES	MECHANICAL
M0603	MECHANICAL SCHEDULES	MECHANICAL
M0604	HVAC SYSTEM DDC MONITORING POINTS	MECHANICAL
FP0101	FIRE PROTECTION LEGEND	FIRE PROTECTION
FP0102	FIRE PROTECTION NOTES	FIRE PROTECTION
FP0103	BRIDGE FIRE PROTECTION STANDPIPE SEQUENCE OF OPERATION	FIRE PROTECTION
FP0201	TEMPORARY FIRE PROTECTION SEQUENCE OF CONSTRUCTION - APPROACH STRUCTURES	FIRE PROTECTION
FP0202	TEMPORARY FIRE PROTECTION SEQUENCE OF CONSTRUCTION - ARCH STRUCTURE	FIRE PROTECTION
FP0203	EXISTING FIRE PROTECTION DEMOLITION PLAN	FIRE PROTECTION

FP0204	TEMPORARY FIRE PROTECTION PLAN SHEET 1	FIRE PROTECTION
FP0205	TEMPORARY FIRE PROTECTION PLAN SHEET 2	FIRE PROTECTION
FP0206	TEMPORARY FIRE PROTECTION PLAN SHEET 3	FIRE PROTECTION
FP0207	TEMPORARY FIRE PROTECTION PLAN SHEET 4	FIRE PROTECTION
FP0208	TEMPORARY FIRE PROTECTION PLAN SHEET 5	FIRE PROTECTION
FP0209	TEMPORARY FIRE PROTECTION PLAN SHEET 6	FIRE PROTECTION
FP0210	TEMPORARY FIRE PROTECTION PLAN SHEET 7	FIRE PROTECTION
FP0211	FIRE STANDPIPE PLAN SHEET 1	FIRE PROTECTION
FP0212	FIRE STANDPIPE PLAN SHEET 2	FIRE PROTECTION
FP0213	FIRE STANDPIPE PLAN SHEET 3	FIRE PROTECTION
FP0214	FIRE STANDPIPE PLAN SHEET 4	FIRE PROTECTION
FP0215	FIRE STANDPIPE PLAN SHEET 5	FIRE PROTECTION
FP0216	FIRE STANDPIPE PLAN SHEET 6	FIRE PROTECTION
FP0217	FIRE STANDPIPE PLAN SHEET 7	FIRE PROTECTION
FP0218	FIRE STANDPIPE PLAN SHEET 8	FIRE PROTECTION
FP0219	FIRE PROTECTION PLAN NY MECHANICAL/ELECTRICAL BUILDING	FIRE PROTECTION
FP0220	FIRE PROTECTION PLAN NY TOWER ELECTRICAL / ELECTRONICS ROOMS	FIRE PROTECTION
FP0221	FIRE PROTECTION PLAN NY STORAGE BUILDING	FIRE PROTECTION
FP0222	FIRE PROTECTION PLAN NJ MECHANICAL/ELECTRICAL BUILDING	FIRE PROTECTION
FP0223	FIRE PROTECTION PLAN NJ TOWER ELECTRICAL / ELECTRONICS ROOMS	FIRE PROTECTION
FP0301	FIRE STANDPIPE TYPICAL SECTION AT ARCH SUSPENDERS	FIRE PROTECTION
FP0302	FIRE STANDPIPE APPROACH ROADWAY SECTION	FIRE PROTECTION
FP0303	FIRE STANDPIPE PLAN TOWER FLOOR LEVEL	FIRE PROTECTION
FP0304	FIRE STANDPIPE VERTICAL DRAIN RISER DETAILS	FIRE PROTECTION
FP0305	FIRE STANDPIPE ARCH EAST CATWALK SUPPORT PLAN	FIRE PROTECTION
FP0306	FIRE PROTECTION EAST & WEST CATWALK MOUNTING DETAILS	FIRE PROTECTION
FP0400	NEW YORK FIRE PUMP PIPING SCHEMATIC	FIRE PROTECTION
FP0401	NEW JERSEY FIRE PUMP PIPING SCHEMATIC	FIRE PROTECTION
FP0402	FIRE PROTECTION MISCELLANEOUS DETAILS	FIRE PROTECTION
FP0403	FIRE PROTECTION HANGER DETAILS	FIRE PROTECTION
FP0404	FIRE PROTECTION SEISMIC DETAILS	FIRE PROTECTION
FP0405	FIRE PROTECTION SEISMIC DETAILS	FIRE PROTECTION
FP0406	FIRE PROTECTION SPRINKLER DETAILS	FIRE PROTECTION
FP0407	FIRE PROTECTION MOTORIZED VALVE SYSTEM OVERVIEW	FIRE PROTECTION

FP0501	FIRE PROTECTION EQUIPMENT SCHEDULES	FIRE PROTECTION
FP0601	FIRE PROTECTION NEW YORK STORAGE BUILDING WATER SERVICE ENTRANCE DETAIL	FIRE PROTECTION
FP0602	FIRE PROTECTION UNDERGROUND VAULT WATER SERVICE ENTRANCE DETAIL	FIRE PROTECTION
P0101	PLUMBING LEGEND AND FIXTURE SCHEDULE	PLUMBING
P0201	PLUMBING PLAN NEW YORK MECHANICAL / ELECTRICAL BUILDING	PLUMBING
P0202	PLUMBING PLAN NEW JERSEY MECHANICAL / ELECTRICAL BUILDING	PLUMBING
P0203	PLUMBING PLAN NEW YORK STORAGE BUILDING	PLUMBING
P0301	NEW YORK PLUMBING RISER DIAGRAMS	PLUMBING
P0302	NEW JERSEY PLUMBING RISER DIAGRAMS	PLUMBING
P0401	PLUMBING DETAILS	PLUMBING
P0402	PLUMBING DETAILS	PLUMBING
ES0101	ELECTRONICS LEGEND	ELECTRONICS
ES0102	ELECTRONICS ABBREVIATIONS	ELECTRONICS
ES0103	GENERAL NOTES SHEET 1	ELECTRONICS
ES0104	GENERAL NOTES SHEET 2	ELECTRONICS
ES0105	ELECTRONICS KEY MAP SHEET 1	ELECTRONICS
ES0106	ELECTRONICS KEY MAP SHEET 2	ELECTRONICS
ES0201	EXISTING ELECTRONIC SYSTEMS ARCHITECTURE	ELECTRONICS
ES0202	EXISTING ELECTRONIC SYSTEMS LAYOUT PLAN - NEW YORK	ELECTRONICS
ES0203	EXISTING ELECTRONIC SYSTEMS LAYOUT PLAN - NEW JERSEY	ELECTRONICS
ES0204	EXISITNG ADMIN BLDG LAYOUT PLAN	ELECTRONICS
ES0205	EXISTING AT&T CABLE PLAN NY & NJ	ELECTRONICS
ES0206	EXISTING VERIZON CABLE PLAN NEW YORK	ELECTRONICS
ES0207	EXISTING VERIZON CABLE PLAN NEW JERSEY	ELECTRONICS
ES0208	EXISTING TOLL SYSTEM LAYOUT PLAN	ELECTRONICS
ES0301	ELECTRONIC WORK TO BE PERFORMED PRE-STAGE 1	ELECTRONICS
ES0302	ELECTRONIC WORK TO BE PERFORMED STAGE 1	ELECTRONICS
ES0303	ELECTRONIC WORK TO BE PERFORMED STAGE 2 & 3	ELECTRONICS
ES0304	ELECTRONIC WORK TO BE PERFORMED STAGE 4 & 5	ELECTRONICS
ES0305	STAGING ATT FIBER OPTIC INFRASTRUCTURE-SHEET 1	ELECTRONICS
ES0306	PHYSICAL CONSTRUCTION LAYOUT PLAN SHEET 1	ELECTRONICS
ES0307	STAGING BB FIBER OPTIC BACKBONE - SHEET 1	ELECTRONICS
ES0308	STAGING BB FIBER OPTIC BACKBONE - SHEET 2	ELECTRONICS

ES0401	TEMPORARY ELECTRONIC SYSTEM BLOCK DIAGRAM	ELECTRONICS
ES0402	TEMPORARY FIBER OPTIC DISTRIBUTION PANEL SHEET 1	ELECTRONICS
ES0403	TEMPORARY FIBER OPTIC DISTRIBUTION PANEL SHEET 2	ELECTRONICS
ES0404	TEMPORARY FIBER OPTIC SPLICING DIAGRAM	ELECTRONICS
ES0405	TEMPORARY NETWORK SWITCHING DIAGRAM	ELECTRONICS
ES0406	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 1	ELECTRONICS
ES0407	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 2	ELECTRONICS
ES0408	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 3	ELECTRONICS
ES0409	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 4	ELECTRONICS
ES0410	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 5	ELECTRONICS
ES0411	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 6	ELECTRONICS
ES0412	TEMPORARY & REMOVAL DEVICE LAYOUT PLAN SHEET 7	ELECTRONICS
ES0413	TEMPORARY TOLL SYSTEM PLAN - SHEET 1	ELECTRONICS
ES0414	TEMPORARY TOLL SYSTEM PLAN - SHEET 2	ELECTRONICS
ES0415	TEMPORARY & REMOVAL LAYOUT PLAN (AT&T CABLE) SHEET 1	ELECTRONICS
ES0416	TEMPORARY & REMOVAL LAYOUT PLAN (AT&T CABLE) SHEET 2	ELECTRONICS
ES0417	TEMPORARY & REMOVAL LAYOUT PLAN (AT&T CABLE) SHEET 3	ELECTRONICS
ES0418	TEMPORARY & REMOVAL LAYOUT PLAN (VERIZON CABLE)	ELECTRONICS
ES0419	TEMPORARY FIELD EQUIPMENT PANEL LAYOUT AND ELECTRONIC SYSTEM RISER DIAGRAM	ELECTRONICS
ES0420	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 1	ELECTRONICS
ES0421	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 2	ELECTRONICS
ES0422	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 3	ELECTRONICS
ES0423	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 4	ELECTRONICS
ES0424	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 5	ELECTRONICS
ES0425	TEMPORARY & REMOVAL DEVICE LAYOUT FOR	ELECTRONICS

	CCTV AND ACCESS CONTROL SHEET 6	
ES0426	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 7	ELECTRONICS
ES0427	TEMPORARY & REMOVAL DEVICE LAYOUT FOR CCTV AND ACCESS CONTROL SHEET 8	ELECTRONICS
ES0428	TEMPORARY RACK/ STACK NETWORK AND ELECTRONIC SYSTEM CONNECTIVITY DIAGRAM	ELECTRONICS
ES0501	NETWORK AND SYSTEMS ARCHITECTURE DIAGRAM	ELECTRONICS
ES0502	ELECTRONIC SYSTEMS INTERFACE PLAN	ELECTRONICS
ES0503	OVERVIEW-NETWORK ELECTRONIC SECURITY AND ELECTRONIC SYSTEM MANAGEMENT PLATFORM DIAGRAM	ELECTRONICS
ES0504	NETWORK SWITCHING ARCHITECTURE	ELECTRONICS
ES0505	LOGICAL NETWORK SWITCHING ARCHITECTURE SHEET 1	ELECTRONICS
ES0506	LOGICAL NETWORK SWITCHING ARCHITECTURE SHEET 2	ELECTRONICS
ES0507	WIDE AREA NETWORK CONNECTIVITY DIAGRAM	ELECTRONICS
ES0508	WIDE AREA NETWORK CONNECTIVITY DIAGRAM	ELECTRONICS
ES0509	COMMAND, CONTROL AND COMMUNICATION SYSTEM ARCHITECTURE	ELECTRONICS
ES0510	FIBER OPTIC BLOCK DIAGRAM	ELECTRONICS
ES0511	OVERALL FIBER INTERCONNECTION PLAN SHEET 1	ELECTRONICS
ES0512	OVERALL FIBER INTERCONNECTION PLAN SHEET 2	ELECTRONICS
ES0513	FIBER OPTIC SPLICING DETAILS - SHEET 1	ELECTRONICS
ES0514	FIBER OPTIC SPLICING DETAILS - SHEET 2	ELECTRONICS
ES0515	FIBER OPTIC SPLICING DETAILS - SHEET 3	ELECTRONICS
ES0516	ELECTRONIC VIDEO SYSTEM ARCHITECTURE	ELECTRONICS
ES0517	ELECTRONIC VIDEO SYSTEM CONNECTIVITY DIAGRAM	ELECTRONICS
ES0518	ACCESS CONTROL SYSTEM ARCHITECTURE	ELECTRONICS
ES0519	ACCESS CONTROL SYSTEM CONNECTIVITY DIAGRAM	ELECTRONICS
ES0520	EBT/PBX SYSTEM ARCHITECTURE	ELECTRONICS
ES0521	EBT/PBX CONNECTIVITY DIAGRAM	ELECTRONICS
ES0601	DEVICE LAYOUT PLAN - SHEET 1	ELECTRONICS
ES0602	DEVICE LAYOUT PLAN - SHEET 2	ELECTRONICS
ES0603	DEVICE LAYOUT PLAN - SHEET 3	ELECTRONICS
ES0604	DEVICE LAYOUT PLAN - SHEET 4	ELECTRONICS
ES0605	DEVICE LAYOUT PLAN - SHEET 5	ELECTRONICS

ES0606	DEVICE LAYOUT PLAN - SHEET 6	ELECTRONICS
ES0607	DEVICE LAYOUT PLAN - SHEET 7	ELECTRONICS
ES0608	DEVICE LAYOUT PLAN - SHEET 8	ELECTRONICS
ES0609	DEVICE LAYOUT PLAN - SHEET 9	ELECTRONICS
ES0610	DEVICE LAYOUT PLAN - SHEET 10	ELECTRONICS
ES0611	DEVICE LAYOUT PLAN - SHEET 11	ELECTRONICS
ES0612	DEVICE LAYOUT PLAN - SHEET 12	ELECTRONICS
ES0613	DEVICE LAYOUT SECTION DETAIL PLAN	ELECTRONICS
ES0614	PERMENANT TOLL SYSTEM PLAN	ELECTRONICS
ES0615	SYSTEM RISER DIAGRAM - SHEET 1	ELECTRONICS
ES0616	SYSTEM RISER DIAGRAM - SHEET 2	ELECTRONICS
ES0617	SYSTEM RISER DIAGRAM - SHEET 3	ELECTRONICS
ES0618	SYSTEM RISER DIAGRAM - SHEET 4	ELECTRONICS
ES0619	NY ADMIN BUILDING LAYOUT PLAN SHEET 1	ELECTRONICS
ES0620	NY ADMIN BUILDING LAYOUT PLAN SHEET 2	ELECTRONICS
ES0621	NY M/E BUILDING DEVICE LAYOUT PLAN	ELECTRONICS
ES0622	NY M/E BUILDING ELECTRONICS ROOM LAYOUT PLAN	ELECTRONICS
ES0623	NY M/E BUILDING ELECTRONICS ROOM RACK AND STACK LAYOUT PLAN	ELECTRONICS
ES0624	NY M/E BUILDING ELECTRONICS ROOM NETWORK CONNECTIVITY DIAGRAM	ELECTRONICS
ES0625	NJ M/E BUILDING DEVICE LAYOUT PLAN	ELECTRONICS
ES0626	NJ M/E BUILDING ELECTRONICS ROOM LAYOUT PLAN	ELECTRONICS
ES0627	NJ M/E BUILDING ELECTRONICS ROOM RACK AND STACK LAYOUT PLAN	ELECTRONICS
ES0628	NJ M/E BUILDING ELECTRONICS ROOM NETWORK CONNECTIVITY DIAGRAM	ELECTRONICS
ES0629	NY AND NJ TOWER ROOM LAYOUT PLAN	ELECTRONICS
ES0630	NY STORAGE BUILDING LAYOUT	ELECTRONICS
ES0701	TYPICAL FIELD EQUIPMENT PANEL INSTALLATION DETAIL	ELECTRONICS
ES0702	TEMPORARY ELECTRONIC FIELD EQUIPMENT PANEL DETAIL	ELECTRONICS
ES0703	PERMANENT ELECTRONIC FIELD EQUIPMENT PANEL DETAIL	ELECTRONICS
ES0704	PERMANENT ACCESS CONTROL PANEL DETAIL	ELECTRONICS
ES0705	PERMANENT FIBER DISTRIBUTION PANEL	ELECTRONICS
ES0706	ELECTRONIC POWER SUPPLY PANEL DETAIL	ELECTRONICS
ES0707	TRAKA KEY PANEL DETAIL	ELECTRONICS
ES0708	TYPICAL RACK AND STAND ALONE CABINET DETAIL	ELECTRONICS

ES0709	TYPICAL TELEPHONE TERMINAL BOARD INSTALLATION DETAIL	ELECTRONICS
ES0710	TYPICAL SECTION - CONDUITS AT BRIDGE APPROACH STRUCTURE	ELECTRONICS
ES0711	TYPICAL SECTION - CONDUITS AT BRIDGE SPAN	ELECTRONICS
ES0712	TYPICAL SECTION - CONDUIT ENTRY INTO M/E BUILDING ELECTRONICS ROOM	ELECTRONICS
ES0713	M/E BUILDING ELECTRONICS ROOM CABLE LADDER DETAILS	ELECTRONICS
ES0714	TYPICAL SECTION - CONDUIT ENTRY INTO TOWER ELECTRONICS ROOM	ELECTRONICS
ES0715	TEMPORARY TOLL GANTRY 1 & 2 CONDUIT DETAILS	ELECTRONICS
ES0716	PERMANENT TOLL GANTRY CONDUIT DETAILS	ELECTRONICS
ES0717	AT&T CONDUIT INSTALLATION DETAILS	ELECTRONICS
ES0718	TEMPORARY CCTV CAMERA POLE MOUNTING DETAIL AT MID SPAN	ELECTRONICS
ES0719	TEMPORARY CCTV CAMERA POLE MOUNTING DETAIL AT BRIDGE APPROACH	ELECTRONICS
ES0720	TEMPORARY FEP POLE MOUNTING DETAILS	ELECTRONICS
ES0721	CCTV CAMERA MOUNTING DETAILS SHEET 1	ELECTRONICS
ES0722	CCTV CAMERA MOUNTING DETAILS SHEET 2	ELECTRONICS
ES0723	CCTV CAMERA MOUNTING DETAILS SHEET 3	ELECTRONICS
ES0724	CCTV CAMERA MOUNTING DETAILS SHEET 4	ELECTRONICS
ES0725	CCTV CAMERA MOUNTING DETAILS SHEET 5	ELECTRONICS
ES0726	CCTV CAMERA MOUNTING DETAILS SHEET 6	ELECTRONICS
ES0727	CCTV CAMERA MOUNTING DETAILS SHEET 7	ELECTRONICS
ES0728	VOICE EQUIPMENT MOUNTING DETAILS (EMERGENCY PHONE)	ELECTRONICS
ES0729	TYPICAL BUILDING ACCESS CONTROL INSTALLATION DETAIL 1	ELECTRONICS
ES0730	TYPICAL BUILDING ACCESS CONTROL INSTALLATION DETAIL 2	ELECTRONICS
ES0731	TYPICAL BUILDING ACCESS CONTROL INSTALLATION DETAIL 3	ELECTRONICS
ES0732	SCHEDULE - CCTV CAMERA SCHEDULE- SHEET 1	ELECTRONICS
ES0733	SCHEDULE - CCTV CAMERA SCHEDULE- SHEET 2	ELECTRONICS
ES0734	SCHEDULE - ACCESS CONTROL DOOR AND E-LOCK SCHEDULE	ELECTRONICS
ES0735	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE- SHEET 1	ELECTRONICS
ES0736	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE- SHEET 2	ELECTRONICS
ES0737	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE-	ELECTRONICS

	SHEET 3	
ES0738	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE-SHEET 4	ELECTRONICS
ES0739	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE-SHEET 5	ELECTRONICS
ES0740	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE-SHEET 6	ELECTRONICS
ES0741	SCHEDULE - ELECTRONIC SYSTEM SCHEDULE-SHEET 7	ELECTRONICS
E0101	ELECTRICAL SYMBOLS, LEGEND, AND ABBREVIATIONS	ELECTRICAL
E0102	GENERAL NOTES	ELECTRICAL
E0103	LIST OF MANUFACTURERS	ELECTRICAL
E0104	ELECTRICAL SITE PLAN	ELECTRICAL
E0105	KEY MAP - SHEET 1	ELECTRICAL
E0106	KEY MAP - SHEET 2	ELECTRICAL
E0107	ELECTRICAL STAGING PLANS - STAGE 1	ELECTRICAL
E0108	ELECTRICAL STAGING PLANS - STAGE 2	ELECTRICAL
E0109	ELECTRICAL STAGING PLANS - STAGE 3	ELECTRICAL
E0110	ELECTRICAL STAGING PLANS - STAGE 4	ELECTRICAL
E0111	ELECTRICAL STAGING PLANS - STAGE 5	ELECTRICAL
E0112	NY TEMPORARY POWER AND LIGHTING PLAN - SHEET 1	ELECTRICAL
E0113	NY TEMPORARY POWER AND LIGHTING PLAN - SHEET 2	ELECTRICAL
E0201	NY MECHANICAL ELECTRICAL BUILDING ONE LINE	ELECTRICAL
E0202	NY SIDE TOWER ONE LINE	ELECTRICAL
E0203	NJ MECHANICAL ELECTRICAL BUILDING ONE LINE	ELECTRICAL
E0204	NJ SIDE TOWER ONE LINE	ELECTRICAL
E0205	NY TOLLS BUILDING ONE LINE	ELECTRICAL
E0206	NY TOLLS BUILDING ONE LINE - REMOVAL	ELECTRICAL
E0207	NY ABUTMENT ONE LINE - REMOVAL	ELECTRICAL
E0208	NJ ABUTMENT ONE LINE - REMOVAL	ELECTRICAL
E0301	NY TOLLS BUILDING REMOVAL PLAN BASEMENT	ELECTRICAL
E0302	NY ABUTMENT AND TOWER REMOVAL PLANS	ELECTRICAL
E0303	NY TOLL PLAZA TUNNEL REMOVAL PLAN	ELECTRICAL
E0304	NJ ABUTMENT AND TOWER REMOVAL PLANS	ELECTRICAL
E0401	NY UNDERGROUND POWER PLAN	ELECTRICAL
E0402	NJ UNDERGROUND POWER PLAN	ELECTRICAL
E0403	NY PARTIAL SITE PLAN	ELECTRICAL
E0404	NY TOLLS BUILDING BASEMENT POWER PLAN	ELECTRICAL

E0405	NY MECHANICAL ELECTRICAL BUILDING POWER PLAN	ELECTRICAL
E0406	NJ MECHANICAL ELECTRICAL BUILDING POWER PLAN	ELECTRICAL
E0407	NY AND NJ TOWER POWER PLAN	ELECTRICAL
E0408	NY STORAGE BUILDING POWER PLAN	ELECTRICAL
E0409	NY SALT STORAGE SHED AND EXISTING HAZMAT STORAGE SHED POWER PLAN	ELECTRICAL
E0410	AUTOMATIC TRANSFER SWITCH SEQUENCE OF OPERATIONS	ELECTRICAL
E0411	NY MECHANICAL ELECTRICAL BUILDING GROUNDING PLAN	ELECTRICAL
E0412	NJ MECHANICAL ELECTRICAL BUILDING GROUNDING PLAN	ELECTRICAL
E0413	NY TOWER GROUNDING PLAN	ELECTRICAL
E0414	NJ TOWER GROUNDING PLAN	ELECTRICAL
E0415	NY STORAGE BUILDING GROUNDING PLAN	ELECTRICAL
E0416	NY MECHANCIAL ELECTRICAL BUILDING LIGHTNING PROTECTION SYSTEM PLAN	ELECTRICAL
E0417	NJ MECHANICAL ELECTRICAL BUILDING LIGHTNING PROTECTION SYSTEM PLAN	ELECTRICAL
E0418	PERMANENT TOLL GANTRY LIGHTNING PROTECTION SYSTEM PLAN	ELECTRICAL
E0419	AVIATION LIGHT LIGHTNING PROTECTION SYSTEM PLAN	ELECTRICAL
E0420	NY STORAGE BUILDING LIGHTNING PROTECTION SYSTEM PLAN	ELECTRICAL
E0421	POWER SITE PLAN - SHEET 1	ELECTRICAL
E0422	POWER SITE PLAN - SHEET 2	ELECTRICAL
E0423	POWER SITE PLAN - SHEET 3	ELECTRICAL
E0424	POWER SITE PLAN - SHEET 4	ELECTRICAL
E0425	POWER SITE PLAN - SHEET 5	ELECTRICAL
E0426	POWER SITE PLAN - SHEET 6	ELECTRICAL
E0427	POWER SITE PLAN - SHEET 7	ELECTRICAL
E0428	POWER SITE PLAN - SHEET 8	ELECTRICAL
E0429	POWER SITE PLAN - SHEET 9	ELECTRICAL
E0430	POWER SITE PLAN - SHEET 10	ELECTRICAL
E0431	NY TOWER AREA CONDUIT ROUTING DIAGRAM - SHEET 1	ELECTRICAL
E0432	NY TOWER AREA CONDUIT ROUTING DIAGRAM - SHEET 2	ELECTRICAL
E0433	SOUTH UPPER CORD AND UPPER DECK AREA CONDUIT ROUTING DIAGRAM	ELECTRICAL
E0434	SOUTH LOWER CORD AND UPPER DECK AREA	ELECTRICAL

	CONDUIT ROUTING DIAGRAM	
E0435	NORTH LOWER CORD AND UPPER DECK AREA CONDUIT ROUTING DIAGRAM	ELECTRICAL
E0436	NORTH UPPER CORD AND UPPER DECK AREA CONDUIT ROUTING DIAGRAM	ELECTRICAL
E0437	NJ TOWER AREA CONDUIT ROUTING DIAGRAM - SHEET 1	ELECTRICAL
E0438	NJ TOWER AREA CONDUIT ROUTING DIAGRAM - SHEET 2	ELECTRICAL
E0501	ELECTRICAL CONDUIT AND CABLE SCHEDULES - SHEET 1	ELECTRICAL
E0502	ELECTRICAL CONDUIT AND CABLE SCHEDULES - SHEET 2	ELECTRICAL
E0503	ELECTRICAL CONDUIT AND CABLE SCHEDULES - SHEET 3	ELECTRICAL
E0504	ELECTRICAL CONDUIT AND CABLE SCHEDULES - SHEET 4	ELECTRICAL
E0505	ELECTRICAL CONDUIT AND CABLE SCHEDULES - SHEET 5	ELECTRICAL
E0506	ELECTRICAL PANEL SCHEDULES - SHEET 1	ELECTRICAL
E0507	ELECTRICAL PANEL SCHEDULES - SHEET 2	ELECTRICAL
E0508	ELECTRICAL PANEL SCHEDULES - SHEET 3	ELECTRICAL
E0509	ELECTRICAL PANEL SCHEDULES - SHEET 4	ELECTRICAL
E0510	ELECTRICAL PANEL SCHEDULES - SHEET 5	ELECTRICAL
E0511	ELECTRICAL PANEL SCHEDULES - SHEET 6	ELECTRICAL
E0512	ELECTRICAL PANEL SCHEDULES - SHEET 7	ELECTRICAL
E0513	ROADWAY FIXTURE LOCATION SCHEDULES	ELECTRICAL
E0514	ELECTRICAL EQUIPMENT SCHEDULE	ELECTRICAL
E0601	ELECTRICAL DETAILS - SHEET 1	ELECTRICAL
E0602	ELECTRICAL DETAILS - SHEET 2	ELECTRICAL
E0603	ELECTRICAL DETAILS - SHEET 3	ELECTRICAL
E0604	ELECTRICAL DETAILS - SHEET 4	ELECTRICAL
E0605	ELECTRICAL DETAILS - SHEET 5	ELECTRICAL
E0606	ELECTRICAL DETAILS - SHEET 6	ELECTRICAL
E0607	ELECTRICAL DETAILS - SHEET 7	ELECTRICAL
E0608	ELECTRICAL DETAILS - SHEET 8	ELECTRICAL
E0609	ELECTRICAL DETAILS - SHEET 9	ELECTRICAL
E0610	ELECTRICAL DETAILS - SHEET 10	ELECTRICAL
E0611	ELECTRICAL DETAILS - SHEET 11	ELECTRICAL
E0612	ELECTRICAL DETAILS - SHEET 12	ELECTRICAL
E0613	ELECTRICAL DETAILS - SHEET 13	ELECTRICAL
E0614	ELECTRICAL DETAILS - SHEET 14	ELECTRICAL
E0615	ELECTRICAL DETAILS - SHEET 15	ELECTRICAL

E0701	LIGHTING STAGING PLANS - STAGE 1	ELECTRICAL
E0702	LIGHTING STAGING PLANS - STAGE 2	ELECTRICAL
E0703	LIGHTING STAGING PLANS - STAGE 3	ELECTRICAL
E0704	LIGHTING STAGING PLANS - STAGE 4	ELECTRICAL
E0705	LIGHTING STAGING PLANS - STAGE 5	ELECTRICAL
E0706	LIGHTING REMOVAL PLAN - SHEET 1	ELECTRICAL
E0707	LIGHTING REMOVAL PLAN - SHEET 2	ELECTRICAL
E0708	LIGHTING REMOVAL PLAN - SHEET 3	ELECTRICAL
E0709	LIGHTING REMOVAL PLAN - SHEET 4	ELECTRICAL
E0710	LIGHTING REMOVAL PLAN - SHEET 5	ELECTRICAL
E0711	LIGHTING REMOVAL PLAN - SHEET 6	ELECTRICAL
E0712	LIGHTING REMOVAL PLAN - SHEET 7	ELECTRICAL
E0713	LIGHTING REMOVAL PLAN - SHEET 8	ELECTRICAL
E0714	LIGHTING REMOVAL PLAN - SHEET 9	ELECTRICAL
E0715	LIGHTING REMOVAL PLAN - SHEET 10	ELECTRICAL
E0716	NY INTERCHANGE TEMPORARY LTG PHOTOMETRY	ELECTRICAL
E0717	NJ INTERCHANGE TEMPORARY LTG PHOTOMETRY	ELECTRICAL
E0718	ROADWAY LIGHTING PLAN - SHEET 1	ELECTRICAL
E0719	ROADWAY LIGHTING PLAN - SHEET 2	ELECTRICAL
E0720	ROADWAY LIGHTING PLAN - SHEET 3	ELECTRICAL
E0721	ROADWAY LIGHTING PLAN - SHEET 4	ELECTRICAL
E0722	ROADWAY LIGHTING PLAN - SHEET 5	ELECTRICAL
E0723	ROADWAY LIGHTING PLAN - SHEET 6	ELECTRICAL
E0724	ROADWAY LIGHTING PLAN - SHEET 7	ELECTRICAL
E0725	ROADWAY LIGHTING PLAN - SHEET 8	ELECTRICAL
E0726	ROADWAY LIGHTING PLAN - SHEET 9	ELECTRICAL
E0727	ROADWAY LIGHTING PLAN - SHEET 10	ELECTRICAL
E0728	NY AESTHETIC ARCH LIGHTING CIRCUITRY/ CONDUIT RUNS	ELECTRICAL
E0729	NJ AESTHETIC ARCH LIGHTING CIRCUITRY/ CONDUIT RUNS	ELECTRICAL
E0730	NY MECHANICAL ELECTRICAL BUILDING LIGHTING PLAN	ELECTRICAL
E0731	NJ MECHANCIAL ELECTRICAL BUILDING LIGHTING PLAN	ELECTRICAL
E0732	NY AND NJ TOWER LIGHTING PLAN	ELECTRICAL
E0733	NY STORAGE BUILDING LIGHTING PLAN	ELECTRICAL
E0734	NY SALT STORAGE SHED LIGHTING PLAN	ELECTRICAL
E0735	LIGHTING DETAILS - SHEET 1	ELECTRICAL
E0736	LIGHTING DETAILS - SHEET 2	ELECTRICAL
E0737	LIGHTING DETAILS - SHEET 3	ELECTRICAL
E0738	LUMINAIRE SCHEDULE - SHEET 1	ELECTRICAL

E0739	LUMINAIRE SCHEDULE - SHEET 2	ELECTRICAL
E0740	NY AND NJ ROADWAY LIGHTING ONE LINE	ELECTRICAL
E0741	NY AND NJ ABUTMENT AESTHETIC LIGHTING CIRCUITRY/ CONDUIT RUNS	ELECTRICAL
E0801	SYMBOLS AND ABBREVIATIONS	FIRE ALARM
E0802	FIRE ALARM GENERAL NOTES	FIRE ALARM
E0803	NY MECHANCIAL ELECTRICAL BUILDING FA SYSTEM DEVICE LAYOUT	FIRE ALARM
E0804	NJ MECHANICAL ELECTRICAL BUILDING FA SYSTEM DEVICE LAYOUT	FIRE ALARM
E0805	NY AND NJ TOWER FA SYSTEM DEVICE LAYOUT	FIRE ALARM
E0806	NY STORAGE BUILDING FA SYSTEM DEVICE LAYOUT	FIRE ALARM
E0807	NY MECHANICAL ELECTRICAL BUILDING AND TOWER FA SYSTEM RISERS	FIRE ALARM
E0808	NJ MECHANICAL ELECTRICAL BUILDING AND TOWER FA SYSTEM RISERS	FIRE ALARM
E0809	NY MECHANICAL ELECTRICAL BUILDING AND TOWER FA SYSTEM MATRIX	FIRE ALARM
E0810	NJ MECHANICAL ELECTRICAL BUILDING AND TOWER FA SYSTEM MATRIX	FIRE ALARM
E0811	FA SYSTEM ARCHITECTURE COMMUNICATION ONE LINE	FIRE ALARM
E0812	FA SYSTEM INSTALLATION WIRING DETAILS	FIRE ALARM
E0901	SCADA SYSTEM SYMBOLS, LEGEND, GENERAL NOTES	SCADA
E0902	SCADA SYSTEM BLOCK DIAGRAM	SCADA
E0903	SCADA SYSTEM ADMIN BUILDING WIRING DIAGRAM	SCADA
E0904	SCADA SYSTEM NY M/E BUILDING WIRING DIAGRAMS - SHEET 1	SCADA
E0905	SCADA SYSTEM NY M/E BUILDING WIRING DIAGRAMS - SHEET 2	SCADA
E0906	SCADA SYSTEM NY M/E BUILDING WIRING DIAGRAMS - SHEET 3	SCADA
E0907	SCADA SYSTEM NY TOWER ROOM WIRING DIAGRAMS	SCADA
E0908	SCADA SYSTEM NJ TOWER ROOM WIRING DIAGRAMS	SCADA
E0909	SCADA SYSTEM NJ M/E BUILDING WIRING DIAGRAMS - SHEET 1	SCADA
E0910	SCADA SYSTEM NJ M/E BUILDING WIRING DIAGRAMS - SHEET 2	SCADA
E0911	SCADA SYSTEM NJ M/E BUILDING WIRING DIAGRAMS - SHEET 3	SCADA

E0912	SCADA SYSTEM ADMIN BUILDING EQUIPMENT LAYOUT	SCADA
E0913	SCADA SYSTEM NY M/E BUILDING EQUIPMENT LAYOUT	SCADA
E0914	SCADA SYSTEM TOWER ROOMS EQUIPMENT LAYOUT	SCADA
E0915	SCADA SYSTEM NJ M/E BUILDING EQUIPMENT LAYOUT	SCADA
E0916	SCADA SYSTEM CABINET SCHEDULE AND DETAILS	SCADA
E0917	SCADA SYSTEM MOUNTING AND INSTALLATION DETAILS - SHEET 1	SCADA
E0918	SCADA SYSTEM MOUNTING AND INSTALLATION DETAILS - SHEET 2	SCADA
E0919	SCADA SYSTEM CONDUIT AND CABLE SCHEDULE	SCADA
E0920	SCADA SYSTEM I/O POINT LIST - SHEET 1	SCADA
E0921	SCADA SYSTEM I/O POINT LIST - SHEET 2	SCADA
E0922	SCADA SYSTEM I/O POINT LIST - SHEET 3	SCADA
E1101	AESTHETIC LIGHTING ARCH LAYOUT PLAN- SHEET 1	AESTHETIC BRIDGE LIGHTING
E1102	AESTHETIC LIGHTING ARCH LAYOUT PLAN- SHEET 2	AESTHETIC BRIDGE LIGHTING
E1103	AESTHETIC LIGHTING ARCH LAYOUT PLAN- SHEET 3	AESTHETIC BRIDGE LIGHTING
E1104	AESTHETIC LIGHTING ARCH LAYOUT PLAN- SHEET 4	AESTHETIC BRIDGE LIGHTING
E1105	AESTHETIC LIGHTING ARCH ELEVATION- SHEET 1	AESTHETIC BRIDGE LIGHTING
E1106	AESTHETIC LIGHTING ARCH ELEVATION- SHEET 2	AESTHETIC BRIDGE LIGHTING
E1107	AESTHETIC LIGHTING ARCH ELEVATION- SHEET 3	AESTHETIC BRIDGE LIGHTING
E1108	AESTHETIC LIGHTING ARCH ELEVATION- SHEET 4	AESTHETIC BRIDGE LIGHTING
E1109	AESTHETIC LIGHTING ARCH MOUNTING DETAIL- SHEET 1	AESTHETIC BRIDGE LIGHTING
E1110	AESTHETIC LIGHTING ARCH MOUNTING DETAIL- SHEET 2	AESTHETIC BRIDGE LIGHTING
E1111	AESTHETIC LIGHTING NJ ABUTMENT PLAN	AESTHETIC BRIDGE LIGHTING
E1112	AESTHETIC LIGHTING NJ ABUTMENT ELEVATION	AESTHETIC BRIDGE LIGHTING
E1113	AESTHETIC LIGHTING NY ABUTMENT PLAN	AESTHETIC BRIDGE LIGHTING
E1114	AESTHETIC LIGHTING NY ABUTMENT ELEVATION	AESTHETIC BRIDGE LIGHTING
E1115	AESTHETIC LIGHTING ABUTMENT MOUNTING DETAIL	AESTHETIC BRIDGE LIGHTING
E1116	AESTHETIC LIGHTING LIGHTING CONTROL	AESTHETIC BRIDGE LIGHTING
E1117	AESTHETIC LIGHTING LIGHTING CONTROL ZONE SUMMARY	AESTHETIC BRIDGE LIGHTING

The Contract Drawings do not show all of the details of the Work and are intended only to illustrate the character and extent of the Work to be performed. Accordingly, they may be supplemented during the performance of the Work by the Engineer or by the Contractor subject to the approval of the Engineer, to the extent necessary to further illustrate the Work.

An indication on the Contract Drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials does not constitute a representation as to the conclusions to be drawn therefrom nor a representation that no others exist in addition to those shown, even in the same location; nor does the absence of any indication on said drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials constitute a representation that none exist.

After the Contract has been executed, the Contractor will be furnished six (6) copies of the Specifications and Contract Drawings without charge.

88. REFERENCE DRAWINGS

The following drawings, called Reference Drawings, were not prepared by the Authority or by others for use in connection with this Contract, but they were prepared for other purposes, such as for other contracts or for design purposes for this or other contracts, and are furnished to the Contractor to give him such information as may be in the possession of the Authority. Said drawings are as follows:

DWG. NO.	TITLE
BD-RC1E	NYSDOT-PERMANENT CONCRETE BARRIER FOR STRUCTURES (HALF SECTIONS)
BD-RC14E	NYSDOT - CONCRETE F-SHAPED BARRIER TRANSITION TO HIGHWAY BOX BEAM END CONNECTION DETAILS
BD-OS3E	NYSDOT - OVERHEAD SIGN STRUCTURES - SPAN STRUCTURES FOUNDATION
625-01	NYSDOT - R.O.W. AND SURVEY MARKERS
BCD-507-7	NJDOT BRIDGE CONSTRUCTION DETAILS
CD-157-1	NJDOT - MONUMENT AND MONUMENT BOX
H-1005	NYCDOT - BUS STOP IN ROADWAY
H-1044	NYCDOT - CONCRETE CURB
H-1045	NYCDOT - CONCRETE SIDEWALK
H-1046A	NYCDOT - PROTECTIVE TREE BARRIER
H-1011	NYCDOT - SIDEWALK PEDESTRIAN RAMPS
H-1042A	NYCDOT - STANDARD TRENCH OR HOLE RESTORATION FOR STREETS PROTECTED BY NYC ADMINISTRATIVE CODE 19-144
H-1010	NYCDOT - STEEL FACED CONCRETE CURB STEEL FACING TYPE D
H-1015	NYCDOT - STEEL FACED DROP CURB DRIVEWAYS
H-1034	NYCDOT - TYPICAL CONSTRUCTION JOINTS FOR CONCRETE BASE FOR PAVEMENT
H-1033	NYCDOT - TYPICAL RESURFACING ON ASPHALT PAVEMENT &/OR WEARING COURSE (LESS THAN FULL WIDTH)

MB-1	NJTA - BRIDGE MEDIAN BARRIER
CA-D1	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES GENERAL NOTES AND ELEVATION
CA-D2	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES STRUCTURE AND FOUNDATION SCHEDULES
CA-D3	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES FOUNDATION DETAILS
CA-D4	NJDOT CANTILEVER SIGN SUPPORT STRUCTRUES TRUSS AND POST DETAILS - SHEET 1
CA-D5	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES TRUSS AND POST DETAILS - SHEET 2
CA-D6	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES POST BASE AND FOUNDATION DETAILS
CA-D7	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES SIGN AND LIGHTING SYSTEM DETAILS
CA-D8	NJDOT CANTILEVER SIGN SUPPORT STRUCTURES TYPICAL ELECTRICAL DETAILS
CA-G1	NJDOT CANTILEVER SIGN SUPPORT STANDARDS GENERAL INFORMATION
CA-G2	NJDOT CANTILEVER SIGN SUPPORT STANDARDS GENERAL CRITERIA
CA-G3	NJDOT CANTILEVER SIGN SUPPORT STANDARDS DESIGN TABLES STEEL TRUSSES AND STEEL POSTS
CA-G4	NJDOT OVERHEAD SIGN SUPPORT STANDARDS PEDESTAL AND BARRIER PEDESTAL DESIGN TABLES AND DETAILS
CA-G5	NJDOT CANTILEVER SIGN SUPPORT STANDARDS FOOTING DESIGN TABLES AND DETAILS
CD-159-1	NJDOT TRAFFIC CONTROL DEVICES 1
CD-159-2	NJDOT TRAFFIC CONTROL DEVICES 2
CD-159-3	NJDOT CONSTRUCTION BARRIER CURB TYPE 1
CD-159-4	NJDOT CONSTRUCTION BARRIER CURB TYPE 4 ALTERNATE A
CD-159-5	NJDOT CONSTRUCTION BARRIER CURB TYPE 4 ALTERNATE B
CD-159-6	NJDOT CONSTRUCTION SIGNS 1
CD-159-7	NJDOT CONSTRUCTION SIGNS 2
OH-D1	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES GENERAL NOTES, PLAN AND ELEVATIONS
OH-D2	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES SCHEDULE OF STRUCTURES
OH-D3	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES SCHEDULE OF FOUNDATIONS AND MISCELLANEOUS DETAILS
OH-D4	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES FOUNDATION DETAILS
OH-D5	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES STEEL TRUSS DETAILS - 1
OH-D6	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES STEEL TRUSS DETAILS - 2
OH-D7	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES STEEL TOWER DETAILS
OH-D8	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES TOWER SHAFT BASE AND TRUSS SEAT DETAILS
OH-D9	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES SIGN AND LIGHTING

	SYSTEM SUPPORT DETAILS
OH-D10	NJDOT OVERHEAD SIGN SUPPORT STRUCTURES TYPICAL ELECTRICAL DETAILS
OH-G1	NJDOT OVERHEAD SIGN SUPPORT STANDARDS GENERAL INFORMATION
OH-G2	NJDOT OVERHEAD SIGN SUPPORT STANDARDS GENERAL CRITERIA
OH-G3	NJDOT OVERHEAD SIGN SUPPORT STANDARDS DESIGN TABLES 1
OH-G4	NJDOT OVERHEAD SIGN SUPPORT STANDARDS DESIGN TABLES 2
OH-G5	NJDOT OVERHEAD SIGN SUPPORT STANDARDS PEDESTAL AND BARRIER PEDESTAL DESIGN TABLES AND DETAILS
OH-G6	NJDOT OVERHEAD SIGN SUPPORT STANDARDS FOOTING DESIGN TABLES AND DETAILS
TCD-1	NJDOT TRAFFIC CONTROL DETAILS GENERAL NOTES
TCD-2	NJDOT TRAFFIC CONTROL DETAILS CONSTRUCTION BARRIER
TCD-14	NJDOT TRAFFIC CONTROL DETAILS 4 & 6 LANES, DIVIDED, LANE & SHOULDER CLOSING
TCD-15	NJDOT TRAFFIC CONTROL DETAILS 4 & 6 LANES, DIVIDED, LEFT LANE CLOSING
CM-2	NJTA OVERHEAD SPAN PLAN AND ELEVATION
CM-5	NJTA OVERHEAD SPAN TRUSS AND FENCE DETAILS
CM-4	NJTA OVERHEAD SPAN TRUSS AND FIELD SPLICE DETAILS
TP-1	NJTA TRAFFIC PROTECTION STANDARD DRAWING RIGHT LANE CLOSING
TP-2	NJTA TRAFFIC PROTECTION STANDARD DRAWING RIGHT SHOULDER CLOSING
TP-24	NJTA PRECAST CONCRETE CONSTRUCTION BARRIER TYPE 4 - ALT A
TP-25	NJTA PRECAST CONCRETE CONSTRUCTION BARRIER TYPE 4 - ALT B
E-21	NJTA SIGN LIGHTING DETAILS 1
E-22	NJTA SIGN LIGHTING DETAILS 2
SI-16A	NJTA SPAN TYPE SIGN STRUCTURE (STEEL) TRUSS DETAILS 1
SI-16B	NJTA SPAN TYPE SIGN STRUCTURE (STEEL) TRUSS DETAILS 2
SI-17A	NJTA SPAN TYPE SIGN STRUCTURE (STEEL) END FRAME DETAILS 1
SI-17B	NJTA SPAN TYPE SIGN STRUCTURE (STEEL) END FRAME DETAILS 2
SI-22	NJTA OVERHEAD AND GROUND MOUNTED FOUNDATION DETAILS
SI-22A	NJTA SPAN TYPE SIGN STRUCTURE DRILLED SHAFT FOUNDATION DETAILS
SI-28	NJTA VIERENDEEL SPAN TYPE SIGN STRUCTURE (60'-90') ELEV AND GEN NOTES
SI-29	NJTA VIERENDEEL SPAN TYPE SIGN STRUCTURE (60'-90') SECTIONS AND DETAILS 1
SI-30	NJTA VIERENDEEL SPAN TYPE SIGN STRUCTURE (60'-90') SECTIONS AND DETAILS 2
SI-39	NJTA SPAN TYPE SIGN STRUCTURE FOUNDATION DETAILS (60'-90')
SI-42	NJTA SIGN ATTACHMENT SECTION AND DETAILS
NA	Bayonne Little League Field Draft Deed Notice – "Restricted Area Map" Exhibit B-1a

NA	Bayonne Little League Field Draft Deed Notice – "Restricted Area Map With Engineering Controls" Exhibit B-1b
NA	Bayonne Little League Field Draft Deed Notice – "Restricted Area Data Table" Exhibit B-2
NA	Bayonne Little League Field Draft Deed Notice – "Restricted Area" Exhibit C-2a

An indication on the Reference Drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials does not constitute a representation as to the conclusions to be drawn there from nor a representation that no others exist in addition to those shown, even in the same location; nor does the absence of any indication on said drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials constitute a representation that none exist.

89. SHOP DRAWINGS, CATALOG CUTS AND SAMPLES

The Contractor shall specifically prepare for this Contract all Shop Drawings which may be required in addition to the Contract Drawings or in addition to any other drawings which the Engineer may issue in supplementing the Contract Drawings.

The specific requirements elsewhere set forth in the Specifications for furnishing Shop Drawings, Catalog Cuts and samples for any particular portion of the Contract shall not limit the obligation of the Contractor to furnish Shop Drawings, Catalog Cuts and samples for any other portion when so required by the Engineer.

The Contractor shall submit a general "Submittal Schedule" for the Engineer's review and approval listing the planned transmittal date and estimated number in each specification section category of Shop Drawings, Catalog Cuts, pages of calculations and samples within 30 days after receipt by the Contractor of the acceptance of the Proposal. A more detailed schedule shall be submitted no less than 30 calendar days prior to the actual date of any submittal.

After checking and verifying all field measurements and after complying with applicable procedures specified hereunder, the Contractor shall submit to the Engineer for review and approval, in accordance with the approved schedule of Shop Drawing submissions, or for other action if so indicated by the Engineer, six copies, unless otherwise requested, of all Shop Drawings which will bear a specific written indication that the Contractor has reviewed the submission for conformance to the requirements of the Contract Drawings and Specifications.

The Port Authority uses software, similar to Oracle Primavera Contract Management (formerly known as Expedition), to track the status of Submittals provided by the Contractor. In order to facilitate this electronic tracking, the Contractor shall use the transmittal form that is provided at the pre-construction meeting, and shall forward it to the Engineer via a MAPI compliant e-mail system (e.g. Microsoft Outlook, CC mail, Lotus notes, etc.).

The Contractor's transmittals of Submittal data shall fully comply with the numbering and naming conventions and other procedures that will be provided by the Engineer to the Contractor at the pre-construction meeting.

All submissions shall contain specific reference to the contract drawing and technical specification section to which they apply, as indicated below or as otherwise identified, as the Engineer may require. In general, submissions shall specifically reference Contract Drawing numbers or Specification section numbers for which the item pertains. The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, conformance to the specified performance and design criteria, materials, test results and similar information to enable the Engineer to review the submittal as required.

The Contractor shall also submit six copies to the Engineer for review and approval pursuant to the approved submittal schedule, of all Catalog Cuts and samples for conformance to the requirements of the Contract Drawings and Specifications. All Catalog Cuts and samples shall have been reviewed by the Contractor and shall be accompanied by a specific written indication that the Contractor has reviewed the submittal for conformance with the Contract Drawings and Specifications and shall be identified clearly as to material, supplier, manufacturer's procedures and pertinent data such as catalog numbers and the use for which intended.

Before submission of each Shop Drawing, Catalog Cut and sample, the Contractor shall have determined and verified all quantities, dimensions, conformance to the specified performance and design criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed and coordinated each Shop Drawing or Catalog Cut with other Shop Drawings and Catalog Cuts and with other requirements of the Work.

At the time of each submission, the Contractor shall give the Engineer specific written notice of each variation in any Shop Drawing, Catalog Cut and sample from the requirements of the Contract Drawings or Specifications and, in addition, shall cause a specific notation of each such variation to be made on each submittal to the Engineer, for review and approval of each such variation.

The Engineer's review and approval of Shop Drawings, Catalog Cuts or samples shall not relieve the Contractor from responsibility for any variation from the requirements of the Contract Drawings or Specifications unless the Contractor has in writing called the Engineer's attention to each such variation at the time of submission as required hereunder and the Chief Engineer has given written approval of each by an express specific written notation thereof incorporated in or accompanying the Shop Drawing, Catalog Cut or sample approval. Approval of Shop Drawings, Catalog Cuts and samples which are inconsistent with the requirements of the Contract Drawings and Specifications shall not be deemed to waive or change such requirements or to relieve the Contractor of his obligations to perform such requirements unless the Chief Engineer shall expressly and specifically state that he is waiving or changing such requirements, as stated above.

Where a Shop Drawing, Catalog Cut or sample is required no related Work shall be performed prior to the Engineer's review and approval of the submission.

The format for Shop Drawings prepared by the Contractor shall be as follows: Standard "D" size drawings with outside cut line dimensions of 22 inches by 34 inches and showing in detail all dimensions and description of materials. Two borders shall be drawn. The first shall be drawn one-half inch from the outside edges (top, bottom, left and right). The second shall be drawn inward to the drawing, one-half inch from the top, bottom and right border lines and one and one-half inch from the left border line. The inside borders on these drawings shall be 20 inches by 31 inches. A title block shall be shown on the right side of the drawing adjacent to the inside border identifying the Contractor's Name, Contract Title, Contract Number, cross-referenced Contract drawing number, Specification reference number and related paragraph and applicable signatures. These drawings shall be arranged in systematic order and numbered consecutively.

Upon receipt of the submittal, the Engineer will review the Shop Drawing, Catalog Cut or sample for conformance to the design information and materials shown on the Contract Drawings and contained in the Specifications. Approval by the Engineer shall not constitute a complete review or approval of the means, methods, techniques, sequences or procedures of construction, except where a specific means, method, technique, sequence or procedure of construction is specifically delineated in or required by the Contract Drawings or Specifications, and the approval shall not constitute a review and approval in regard to safety precautions or programs incident thereto. The review and approval of a separate item will not in itself indicate approval of the assembly in which the item functions. Any design shown on the Shop Drawings and prepared by the Contractor, his subcontractors, their detailers, or their professional engineers is the complete responsibility of the Contractor.

Within the number of working days hereinafter specified after receipt of the Shop Drawing prints, the Engineer shall approve or not approve the same or require corrections or additions to be made thereon. When a shop drawing is not approved or if additions or corrections are required, the Engineer shall return within this period one of the six copies submitted and the Contractor shall make the revisions, corrections or additions shown thereon to be made. The Contractor shall resubmit six prints showing the drawing corrected as required. The Contractor shall direct specific attention in writing to revisions other than the corrections called for by the Engineer on the previous submittal. Each drawing shall be corrected as required until the approval of the Engineer is obtained. After each resubmission, the Engineer shall have the number of working days hereinafter specified in which to approve revisions or corrections.

The number of working days within which the Engineer will advise the Contractor as to whether the Shop Drawings are approved, not approved, or require corrections or additions to be made thereto shall be as follows, except that 20 working days shall be required for the Engineer to review shop drawings submitted with design calculations.

No. of Dwgs. Submitted Within 5 Consecutive Working Days for Each Discipline(*)	No. of Working Days for Engineer To Review Shop Drawings
Up to 50	10
51 to 75	15
More than 75	20
* Disciplines shall be defined as follows: Approach Structure, Arch Structure, Architectural, Civil, Geotechnical, Mechanical, Electrical, Traffic and Environmental.	

Failure of the Contractor to provide 30 calendar days advance notice to the Engineer of any submittal shall result in a five (5) working day extension of the number of working days stated in the chart above. In no event shall an extension of the Engineer's review time provided for in this section relieve the Contractor from its duty to meet all contractual Milestone dates.

After approval has been given to any Shop Drawing or Catalog Cut no change will be permitted thereon unless approved in writing by the Engineer.

Before final payment for the Work is made, the Contractor shall submit to the Engineer only those previously approved or approved as noted Shop Drawings, which have been revised by field changes.

The Contractor shall mark-up the approved and approved as noted Shop Drawings directing specific attention to revisions reflecting the permanent construction as actually made. In accordance with the requirements specified in this numbered Section, the Contractor shall submit one original print of these drawings, marked "FINAL SHOP DRAWING – NOT FOR REVIEW", dated, and signed by the Contractor to the Engineer for verification. By signature, the Contractor is verifying that the drawing reflects the as-constructed condition.

All drawings, data, calculations and other papers of any type whatsoever, whether in the form of writing, figures or delineations, which are prepared in connection with this Contract and submitted to the Authority shall become the property of the Authority. The Authority shall have the non-exclusive right to use or permit the use of all such drawings, data and other papers and any ideas or methods represented thereby for any purpose and at any time without additional compensation. No such papers shall be deemed to have been given in confidence. Any statement or legend to the contrary in connection with such drawings, data or other papers and in conflict with the provisions of this paragraph shall be void and of no effect.

90. SUBSTITUTION

Where a proprietary item or make is specified or mentioned herein or called for or mentioned on the Contract Drawings and the phrases "similar and equal to" or "approved equal" are used in connection therewith, the utilization of any other item or make will be deemed a substitution. Substitution for the proprietary item or make specifically named may be made only in accordance with the Section hereof entitled "Workmanship and Materials" and in accordance with the following.

Whenever materials or equipment are specified or described in the Contract Drawings or Specifications by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of another supplier or manufacturer may be accepted by the Engineer if sufficient information and proof is submitted by the Contractor to permit the Engineer to determine that the material or equipment proposed is equivalent or equal to that named and the Engineer approves the substitution. The procedure for review by the Engineer will include the following. Requests for review of substitute items of material and equipment will not be accepted by the Engineer from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make a timely written application to the Engineer for approval thereof, certifying that the proposed substitution will perform at least the identical functions and achieve at least the identical results called for by the specified product and otherwise be equal to the specified product with regard to, but not limited to, durability, maintenance, strength, energy costs and record of proven performance. The application shall state that the evaluation and approval of the proposed substitution shall not delay the Contractor's completion of the Work as required by the Contract, whether or not approval of the substitution will require a change in the construction and, in no event will the Contractor be granted an extension of time for completion of any portion of the Work for reasons related directly or indirectly to the evaluation of the proposed substitution or to the proposed substitution itself. Any variations of the proposed substitution from that specified shall be identified in the application, and maintenance, repair and replacement services for the substitution shall be indicated. The Engineer may require the Contractor to furnish at the Contractor's expense additional laboratory test data concerning the proposed substitution.

Such submission to the Engineer shall be made only by including the requested substitution in the list of materials required to be submitted to the Engineer in accordance with the Section hereof entitled "Inspections and Rejections" within forty-five calendar days after the receipt of the acceptance of the Contractor's Proposal. After the approval of said list, no substitutions will be permitted, except that a brand or make named in the Specifications may be submitted for approval in lieu of a brand or make on said list. Any such submission shall not imply, or impose on the Engineer, any obligation whatsoever to discuss, disclose or justify the reasons for his opinion, approval, acceptance or rejection.

The Engineer shall be the sole judge of as to whether a proposed substitution will be approved, and no substitution shall be ordered or utilized without the Engineer's prior written approval. The Engineer may require Contractor to furnish at Contractor's expense a special performance guarantee or other assurance with respect to any approved substitution. Furthermore, the approval of any substitute proprietary item or make shall not in any way entitle the Contractor to additional compensation therefor.

Notwithstanding such approval, however, the Contractor assumes the risk that such approved substitute item or make is not equal to that shown or specified and if at any time the substitution shall appear not to be so equal he shall replace the substitution with that originally shown on the Contract Drawings or called for in the Specifications at his own cost and reimburse the Authority for any loss occurring on account of the substitution failing to be equal, notwithstanding that it had been previously approved for use by the Engineer.

The construction called for by the Contract Drawings and Specifications may be adapted for a particular proprietary item or make of material or equipment. Therefore, if any construction not required by the Contract Drawings or Specifications in their present form is necessary or desirable because of the use of substitute item or make of material or equipment (even though such other item or make is approved by the Engineer), such construction shall be furnished or performed by the Contractor at his expense and subject to the approval of the Engineer.

91. WORKMANSHIP AND MATERIALS

Workmanship and materials shall in every respect be free from defects of any kind and shall be in accordance with the best modern practice and whenever the Contract Drawings, Specifications or directions of the Engineer admit of a doubt as to what is permissible or fail to note the quality of any construction the interpretation which calls for the best quality is to be followed. Workmanship shall conform to applicable Specifications, manufacturer's instructions and recommendations for installation of products for the applications shown on the Contract Drawings, all of which shall be subject to the provisions of the Section of Division 1 GENERAL PROVISIONS entitled "Inspections and Rejections".

Materials and Equipment incorporated into the Work shall be new except as may be otherwise herein specifically required, and shall comply with make, size, type and quality specified, or as specifically approved in writing by the Chief Engineer in accordance with the Section of Division 1 GENERAL PROVISIONS entitled "Substitution".

Reference to standards of any society, institution, association, or governmental authority in the Specifications or on the Contract Drawings, whether specific or by implication, shall mean for such standards which are part of the building code in effect for Work of this Contract, the edition date published in such code; and such references which are not part of the building code, shall mean the latest edition date in effect at the time of opening of Proposals upon the present Contract unless specifically stated otherwise.

In addition, various paragraphs of these Specifications may contain references to certain standard or tentative specifications or requirements of various organizations. Unless otherwise stated, these references are to be construed as referring to the specifications and requirements in effect on the date set for opening Proposals upon the present Contract.

If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment to be employed by the Contractor in performing the Work. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the approved instructions of the applicable supplier except as otherwise provided in the Contract Drawings or Specifications.

In case of a discrepancy between a description or requirement in the Contract Drawings and Specifications for any material or equipment and a catalog number or other designation for the same material or equipment (even though stated to be acceptable), the description or requirements shall control.

All inventions, ideas, designs and methods contained in the Specifications and Contract Drawings in which the Authority has or may acquire patent, copyright or other property rights are hereby expressly reserved for the exclusive use of the Authority. The Specifications and Contract Drawings contain confidential information which is disclosed only to enable this Contract to be performed. Said Specifications and Drawings must not be used for any purpose detrimental to the interest of the Authority and must not be produced or copied in whole or in part or used for furnishing information to others without the written consent of the Authority, provided, however, that the Contractor may, when the performance of the Contract so requires, furnish said information to others for the purpose of engaging or informing subcontractors and materialmen.

If, in accordance with this Contract, the Contractor furnishes research, development or consultative services in connection with the performance of the Contract and if in the course of such research, development or consultation patentable subject matter is produced by the Contractor, its officers, agents, employees, subcontractors or materialmen, the Authority shall have, without cost or expense to it, an irrevocable, non-exclusive, royalty-free license to make, have made, and use, either itself or by anyone on its behalf, such subject matter in connection with any activity now or hereafter engaged in or permitted by the Authority. Promptly upon request by the Authority, the Contractor shall furnish or obtain from the appropriate person a form of license satisfactory to the Authority, but as between the Contractor and the Authority the license herein provided for shall nevertheless arise for the benefit of the Authority immediately upon the production of said subject matter and shall not await formal exemplification in a written license agreement as provided for above. Such license may be transferred by the Authority to its successors, immediate or otherwise, in the operation or ownership of any real or personal property now or hereafter owned or operated by the Authority, but such license shall not be otherwise transferable.

The right to use all material, software, firmware, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction required in connection with this Contract and to which a patent, copyright or other intellectual property right applies or may apply shall be obtained by the Contractor without separate or additional compensation whether the same is patented, copyrighted or otherwise protected as an intellectual property right before, during or after the performance of the Contract.

The Contractor shall indemnify the Authority against and save it harmless from all loss and expense incurred in the defense, settlement or satisfaction of any claims in the nature of patent, copyright or other intellectual property right infringement arising out of or in connection with the Authority use, in accordance with the preceding two paragraphs of this numbered Section, of such subject matter or material, software, firmware, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction to which a patent, copyright or other intellectual property right applies or may apply. If requested by the Authority and if notified promptly in writing of any such claim, the Contractor shall conduct all negotiations with respect to and defend such claim without expense to the Authority. If the Authority be enjoined from using any of the facilities which form the subject matter of this Contract and as to which the Contractor is to indemnify the Authority against patent, copyright or other intellectual property right claims, the Authority may, at its option and without thereby limiting any other right it may have hereunder or at law or in equity, require the Contractor to supply, temporarily or permanently, facilities not subject to such injunction and not infringing any patent, copyright or other intellectual property right or to remove all such facilities and refund the cost thereof to the Authority or to take such steps as may be necessary to ensure compliance by the Authority with such injunction, all to the satisfaction of the Authority and all without cost or expense to the Authority.

92. CONSTRUCTION SEQUENCE AND ERECTION PROCEDURES FOR THE ARCH SPAN

The Contract Drawings show a sequence, within the overall project staging, for performing the work on the arch and tower spans. The sequence is based on a specific construction sequence and specific construction loads that were applied to the arch, arch members and floor system elements. The sequence and the assumed loads are provided on the Contract Drawings as an example of a particular sequence of construction that maintains stability of the structure during construction, does not overstress the existing steel arch and results in a dead load state after strengthening that is adequate to resist code specified loadings in the elevated roadway condition.

It is the Contractor's responsibility to develop his means and methods of erection and to submit to the Authority for approval a step by step staged analysis of his method of erection to confirm the stability of the structure under construction and to confirm that at all times the design criteria stated below are met. It is also the Contractor's responsibility to maintain the geometry of the existing structure by taking on-going measurements of and making adjustments to the temporary and permanent suspenders.

All analyses prepared by the Contractor shall be in accordance with the AASHTO LRFD Specifications, including Article 3.4.2 Load Factors during Construction. The erection analysis need not consider seismic loads. The Contractor shall consider wind loads based on a wind tunnel test report that will be provided to the successful bidder. A minimum twenty year return period for wind loads shall be used for wind during construction.

The Contractor shall submit to the Authority for approval his construction sequence, including detailed step by step procedures, construction loads and calculations, as well as the procedure for temporary and permanent suspender adjustments. All calculations submitted by the Contractor shall be performed and sealed by a Professional Engineer licensed in both the States of New York and New Jersey, qualified in this type of work, with a minimum of 15 years experience in long span bridge analysis and design including analysis and design of temporary structures.

The overall staging shown for the arch/towers is based on the overall staging for the entire project, including the approaches. The structural analysis, stability and strengthening requirements for the arch are based on the staging described below. The overall staging for the arch/towers and basis of the design is summarized as follows:

- Demolish east half of existing floor system and roadway slab.
- Strengthen ALL arch members. No additional permanent loads shall be applied to the existing arch until it has been completely strengthened.
- Erect new floor system steelwork and the east half of the new roadway slab; transfer traffic to new upper roadway
- Demolish west half of existing roadway slab and all existing floor system steelwork.
- Complete the west half of new upper roadway slab and appurtenances.

The Contractor shall not change this overall staging

The input for the computer model is included as an "Available Document." It is based on LARSA 4D software. The Contractor shall assume all responsibility for its use as provided in the "Available Documents" section of the Contract. Additionally:

The Authority's computer model was created for the use and convenience of the Authority and it may include information and interpretations that may not be meaningful to others. The Authority assumes no responsibility for any interpretations, results, calculations, assessments, strategies or other analytical results derived by others from the computer model. The Authority makes no warranty, express or implied, of any kind, including but not limited to any warranty of fitness for a particular purpose.

93. INSPECTIONS AND REJECTIONS

All Work and all construction, processes of manufacture and methods of construction involved in or related to the performance of the Work shall be at all times and places subject to the inspection of the Engineer, acting personally or through his Inspectors, and the enumeration in these Specifications of particular portions of such Work, construction, processes of manufacture or methods of construction which will or may be inspected by the Engineer or such Inspectors shall not be deemed to imply that only such Work, construction, processes of manufacture and methods of construction will or may be so inspected. The Engineer shall be the judge of the quality and suitability of the Work, construction, processes of manufacture and methods of construction for the purposes for which they are used or to be used. Should they fail to meet his approval they shall be forthwith reconstructed, made good, replaced or corrected, as the case may be, by the Contractor at his own expense. Rejected material shall be removed immediately from the site. The fact that the Inspectors have approved the materials and workmanship shall not relieve the Contractor from his obligation to supply other material and workmanship when so ordered by the Engineer.

The Contractor, at his own expense, shall furnish such facilities and give such assistance for inspection as the Engineer may direct. In the case of materials required by the Specifications to be inspected in the factory or plant, and in the case of any other items which the Engineer may designate, the Contractor shall secure for the Engineer and his Inspectors free access to all parts of such factories or plants and shall furnish to the Engineer three copies of purchase orders, two copies of mill shipping statements and four copies of shipping statements. Moreover, in the case of such materials to be factory or plant inspected, the Contractor shall give at least ten days' notice to the Engineer of his intention to commence the manufacture or preparation of such materials.

Other than the materials and equipment specifically required to be inspected at the manufacturer's factory or plant, all materials will be inspected at the construction site and any portions thereof which are rejected by the Engineer shall be immediately removed from the construction site by the Contractor and shall be replaced with new materials by the Contractor at his own expense.

In the case of materials to be inspected at the construction site, the Contractor shall submit a list of all such materials in triplicate to the Engineer for his approval prior to ordering same. The list shall be submitted within forty-five calendar days after receipt of the notice of acceptance and shall contain the following information:

A. Classification of submittal in accordance with the following:

Class I - A submittal for record of an expressly specified item.

Class II - A submittal of an item which conforms to an express generic specification or a submittal which is deemed by the Contractor to be identical to an expressly specified item.

Class III - A submittal which is deemed by the Contractor to be functionally equivalent but not identical to a specified item.

B. In the case of Class II and Class III, the Contractor shall supply adequate information to the Engineer to enable the Engineer to compare the specified item and the proposed substitution. Information shall include, but need not be limited to, technical specifications, Catalog Cuts, drawings, references to existing installations and test data, or any other data required by the Engineer.

C. In the case of fabricated materials for which Shop Drawings are to be prepared, a brief description of the material and the statement "see Shop Drawings".

D. In the case of materials or equipment listed in manufacturer's catalogs, the list shall contain the vendor's name, the manufacturer's name, brand name, style designation, catalog number and, where the Specifications require catalog cuts, the statement "see catalog cut".

E. In the case of materials or equipment for which Shop Drawings are not to be prepared, and which are not listed in any catalog, the list shall contain a complete description of the material or equipment, which shall be in sufficient detail to describe completely the materials or equipment and quality therefor.

The Engineer shall advise the Contractor whether said list is approved or requires corrections or additions within the number of working days indicated in the chart below:

Type of Submittal	No. of Working Days for Engineer to Approve/Disapprove Items
Class I Material submittals	10
Portland Cement mix designs that require confirmation of the 28-day properties	35
Changes in asphalt mix designs that need to be confirmed with a batch mix at the plant	35
Class II Material submittals	20
Class III Material submittals	30

Failure of the Contractor to provide 30 calendar days advance notice to the Engineer of any submittal shall result in a five (5) working day extension of the number of days stated in the chart above. In no event shall an extension of the Engineer's review time provided for in this section relieve the Contractor from its duty to meet all contractual Milestone dates.

Within ten working days after receipt of said list, the Engineer shall notify the Contractor of which items are approved and which disapproved. Within two working days thereafter, the Contractor shall resubmit a new list covering those items which were disapproved. After each such re-submission the Engineer shall have a similar period of ten days in which to approve or disapprove.

Should materials or equipment be delivered to the construction site without having been placed on the aforementioned list and approved, it shall be immediately removed from the construction site by the Contractor at his own expense.

94. MANUFACTURERS' CERTIFICATION

Where materials and equipment are required by these Specifications to conform to certain standard or tentative specifications or requirements of any organizations, including American Society for Testing and Materials, American National Standards Institute, Association Rules for Grading Lumber, Federal Specifications, National Electrical Manufacturers Association, American Association of State Highway and Transportation Officials, American Water Works Association and the International Municipal Signal Association, the Contractor shall furnish to the Engineer the manufacturer's written certification that each of the materials or equipment conforms to the foregoing standard or tentative specifications. The certification shall be delivered to the Engineer prior to installation of the materials to which it refers. Such certifications shall not be binding or conclusive on the Authority and may be rejected at any time by the Engineer if incorrect, improper or otherwise unsatisfactory in his opinion.

95. NO RELEASE OF CONTRACTOR

Any provision of this Contract for testing, inspection or approval, and any actual testing, inspection or approval, of any materials, workmanship, plant, equipment, drawings, program, methods of procedure, or of any other thing done or furnished or proposed by the Contractor to be done or furnished in connection with the Contract is for the benefit of the Authority not the Contractor. Any approval of such things shall be construed merely to mean that at that time the Engineer knows of no good reason for objecting thereto. No such provision for testing or inspection, no omission of testing or inspection, and no such approval shall release the Contractor from his full responsibility for the accurate and complete performance of the Contract in accordance with the Contract Drawings and Specifications or from any duty, obligation or liability imposed upon him by the Contract or from responsibility for injuries to persons or damage to property.

96. ERRORS AND DISCREPANCIES

If, in the performance of the Contract, the Contractor discovers any errors or omissions in the Contract Drawings or Specifications, or in the marks, lines and elevations furnished by the Authority in the construction undertaken and executed by him, he shall immediately notify the Engineer and the Engineer shall promptly verify the same.

If with the knowledge of such error or omission and prior to the correction thereof, the Contractor proceeds with any construction affected thereby, he shall do so at his own risk and the construction so done shall not be considered as construction done under and in performance of this Contract unless and until approved and accepted.

97. DIFFERING SUBSURFACE CONDITIONS

If during the performance of Work, the Contractor becomes aware of any unanticipated subsurface conditions or has cause to suspect the presence of such condition, then the Contractor shall immediately notify the Engineer, or designee thereof verbally, to be followed immediately by written notification. The Contractor shall specify the nature, location, and impact on the Work of such conditions. The Contractor shall immediately stop Work in and secure the area against injury to persons or damage to property pending further instructions from the Engineer.

The Contractor shall then conduct all necessary investigations and testing of the subsurface conditions as directed by the Engineer to identify the character and extent of the unanticipated subsurface conditions and/or to satisfy applicable Federal, State and local laws, codes and ordinances and regulations and shall notify the Engineer accordingly. The investigation program shall be submitted to the Engineer for review and approval.

In the event the Contractor discovers such subsurface conditions during the performance of the Work and (i) special handling of such condition is necessary and required for the performance of the Work as determined by the Engineer; (ii) such special handling cannot be avoided or mitigated by the exercise of reasonable measures by the Contractor; and (iii) the Contractor actually incurs increased costs caused by such condition that could not have been reasonably anticipated from the Contract Drawings, Reference Drawings and Specifications and inspection of the construction site; then in such event, as approved by the Engineer, the Contractor shall, notwithstanding any provision in this Contract to the contrary, be compensated for such costs for special handling, including the necessary investigations and testing of subsurface conditions, in accordance with the provisions of the Form of Contract clause entitled "Compensation For Extra Work".

98. ACCIDENTS AND FIRST AID PROVISIONS

The Contractor shall promptly report in writing to the Engineer and to the Authority Manager, Claims Administration all accidents whatsoever arising out of or in connection with the performance of the Contract, whether on or adjacent to the construction site, which result in death, injuries or property damage, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damage is caused, the accident shall be reported immediately by telephone to both of the said representatives of the Authority.

The Contractor shall provide at the construction site such equipment and medical facilities as are necessary to supply first aid service, in case of accident, to any who may be injured in the progress of the Contract. He shall have standing arrangements for the removal and hospital treatment of any person who may be injured while engaged in the performance of the Contract.

If any claim is made by any third person against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the fact in writing to the aforementioned representatives of the Authority, giving full details of the claim.

99. SAFETY PROVISIONS

In the performance of the Contract, the Contractor shall exercise every precaution to prevent injury to workers and the public or damage to property.

He shall, at his own expense, provide temporary structures, place such watchmen, design and erect such barricades, fences and railings, give such warnings, display such lights, signals and signs, exercise such precaution against fire, adopt and enforce such rules and regulations, and take such other precautions as may be necessary, desirable or proper, or as may be directed.

The Contractor shall employ for Work of the Contract a competent person conforming to the requirements of the Code of Federal Regulations 29 CFR 1926.32(f) who shall be designated by the Contractor as authorized to perform the duties required by 29 CFR 1926 et seq. as applicable for Work of this Contract.

Obtain and submit to the Engineer one copy of material safety data sheet (MSDS) conforming to the requirements of 29 CFR 1910.1200(g) for each hazardous chemical utilized for permanent and consumable materials employed for Work of this Contract.

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss, including but not limited to:

A. All employees on the Work, the public, and other persons and entities who may be affected thereby;

B. All the Work, materials and equipment to be incorporated therein, whether in storage on or off the site; and

C. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.

The Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and the Contractor has removed all workers, material and equipment from the construction site, or the issuance of the Certificate of Final Completion, whichever shall occur last.

Until fire protection needs are supplied by permanent facilities under this Contract, install and maintain temporary fire protection facilities. Comply with requirements of National Fire Protection Association NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alteration and Demolition Operations".

The Contractor shall employ only such men as are physically fit and are free from contagious or communicable diseases.

The Contractor shall use only machinery and equipment adapted to operate with the least possible noise, and shall so conduct his operations that annoyance to occupants of nearby property and the general public will be reduced to a minimum.

The bringing of intoxicating substances onto the construction site and the use or consumption of intoxicating substances at the construction site are prohibited. It shall be the responsibility of the Contractor to insure that all employees of the Contractor and of all subcontractors, materialmen and any other persons under contract to or under the control of the Contractor shall comply with the provisions of this paragraph.

The Contractor shall daily clean up all refuse, rubbish, scrap materials and debris caused by his operations, to the end that at all times the construction site shall present a neat, orderly and workmanlike appearance. Before the Certificate of Final Completion of Work will be issued, the Contractor shall remove all surplus materials, falsework, temporary fences and other temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations and shall put the construction site in a neat, orderly condition.

In the event the Contractor encounters at the construction site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB) or any other hazardous material not shown on the Contract Drawings or mentioned in the Specifications, the Contractor shall immediately stop Work in the area affected and report the condition in writing to the Engineer. Work in the affected area shall not thereafter be resumed by the Contractor except upon the issuance of a written order to that effect from the Engineer.

Within 15 days of the acceptance of his Proposal, the Contractor shall submit to the Engineer for review, the Contractor's Site Safety Program, which shall be specific for the construction site and include a description of the Work to be performed, a hazard assessment of the Work to be performed and the means by which such hazards shall be mitigated. The Contractor's Site Safety Program shall comply with all applicable federal, state, municipal and local and departmental laws and shall include, among other things, the designation by the Contractor of a qualified individual to administer such Site Safety Program.

Should any vessel, equipment, plant, material, object or debris of any kind used in connection with the Contract or located at or in transit to or from the construction site be sunk, lost, dumped or go adrift under any circumstances, whether or not in navigable water, which in the opinion of the Engineer may, at the time or potentially, be dangerous to or obstruct any navigation or interfere in any way with other work by or for the Authority or with the use of the Authority facilities, the Contractor shall recover and remove the same immediately. The Contractor shall give immediate notice with description and location of such items to the Engineer and when required shall mark or buoy such items until they are removed. The foregoing obligations under this numbered Section shall not be impaired by any right which the Contractor might otherwise have to abandon such vessel, equipment, plant, material, object or debris of any kind without further obligation on his part, and the Contractor waives any such right.

100. RECYCLING OF CONSTRUCTION DEBRIS MATERIAL

The Contractor shall remove from Authority property all construction debris, demolition debris and other debris material generated from the performance of the Work of this Contract unless the material is deemed acceptable by the Engineer for on-site re-use or recycling in accordance with the technical requirements of this Contract and remains at the Work site. The Contractor shall transport to recycling facilities or re-use and recycle on-site for this Contract, as applicable, no less than 75% by weight of the following types of designated debris material, to the extent arising from the Work of this Contract:

Asphalt Concrete
Portland Cement Concrete
Steel
Permanent Steel
Temporary Steel
Aluminum
Ductile Iron Drainage Pipe
Cast Iron (Drainage Frames, Covers, Grates)

During the process of removal of all such designated debris material from Authority property, the Contractor shall submit to the Engineer on a monthly basis a Designated Debris Material Assessment Summary indicating the actual types and quantities by weight of the designated debris material removed for this Contract up to that point in time. In addition, the Designated Debris Material Assessment Summary shall also include types and quantities by weight of designated debris material actually re-used or recycled on-site in this Contract or, if shown on the Contract Drawings, are stockpiled for future use by the Authority. The Designated Debris Material Assessment Summary shall be accompanied by written verification from recycling and landfill destinations identifying the originating Work site, quantity of material delivered and type of debris material for all designated debris material removed from the Work site.

Within 15 days of the acceptance of his Proposal, the Contractor shall submit to the Engineer for review the Contractor's Designated Debris Material Assessment Plan indicating the anticipated types and anticipated quantities by weight and the intended destinations for all such designated debris material to be removed from the Work site. The Designated Debris Material Assessment Plan shall also indicate anticipated types and anticipated quantities by weight of all such designated debris material to remain at the Work site for re-use or recycling in this Contract as applicable.

All removals shall be completed promptly upon the completion of construction under this Contract.

101. DIESEL-POWERED EQUIPMENT

A. The Contractor and its subcontractors shall minimize all air-borne pollutants generated by diesel-powered equipment and vehicles at all times during the performance of this Contract in accordance with this numbered Section. The requirements herein apply to all land-based and barge-mounted diesel-powered construction equipment. Marine propulsion engines, marine auxiliary engines, and dredges used in construction activity are exempt from these requirements.

B. No diesel-powered equipment shall be brought on the construction site without meeting the following requirements unless a waiver has been granted as specified in D. below. In addition, all such equipment and engines shall comply with all Federal, state and local regulations applicable to exhaust emission controls and safety.

1.) Ultra Low Sulfur Diesel (ULSD) Fuel

All diesel-powered equipment to be used in the performance of the Work of this Contract shall use ULSD fuel with an average sulfur content of no more than 15 parts per million (ppm). This requirement applies to on-road and non-road diesel engines. The Engineer may collect samples of the ULSD fuel directly from the fuel tanks of the diesel-powered equipment used on the construction site in order to verify that sulfur concentrations do not exceed 15 ppm. Diesel-powered equipment not using ULSD shall be removed from the construction site or shall immediately comply with the ULSD fuel requirements in this Section as directed by the Engineer and at no additional cost to the Authority.

2.) Emissions Control Devices – Best Available Technology (BAT)

All non-road diesel-powered equipment with a rated horsepower of 50 horse power (hp) or greater and active on the construction site for any portion of a 24-hour workday for more than 20 total consecutive and non-consecutive days shall be retrofitted with Emissions Control Devices (Devices) utilizing the best available technology (BAT). The Devices shall consist of Diesel Particulate Filters (DPFs) or other measures with equivalent particulate matter (PM) removal efficiency, wherever the implementation of such a Device is feasible in the opinion of the Engineer. For non-road diesel-powered equipment rated between 50 hp and 75 hp, Diesel Oxidation Catalysts (DOCs) may be used in place of DPFs.

Both active and passive filter regeneration mechanisms shall be considered for DPFs. In cases where DPFs are not feasible for safety considerations, mechanical reasons, or where the technology would not function properly, the Contractor shall submit a request for a waiver to the Engineer for review and approval prior to the use of such diesel-powered equipment. If the Engineer grants a waiver under these circumstances, then the Contractor shall retrofit the diesel-powered equipment with Flow Through Filters (FTF) if feasible in the opinion of the Engineer. DOCs shall be used in place of DPFs or FTFs unless it is proven to the Engineer by the Contractor that the application of this type of technology is also technically infeasible.

The use of diesel-powered engines greater than 50 hp without tailpipe reduction measures will be permitted pursuant to the Engineer's approval of a written request for a waiver submitted by the Contractor in accordance with D. below.

The use of Devices shall be targeted primarily toward the reduction of PM and secondarily to the reduction of nitrogen oxides (NOX), and shall in no event result in an increase in the emissions of either pollutant. The Devices of best available technology shall be defined as those that are contained in the U.S. Environmental Protection Agency (EPA) Verified Retrofit Technology List, the list of California Air Resources Board (CARB), Verifications, Europe's Verified Technology List (VERT), or as otherwise approved by the Engineer to provide the maximal level of pollutant reductions intended by this Section. For more information, refer to the following websites:

U.S. Environmental Protection Agency Verified Technology List:
http://www.epa.gov/otaq/retrofit/nonroad-list.htm

California Air Resources Board Verified Technology List:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Europe's Verified Technology List:
http://www.akpf.org/pub/vert_filterliste.pdf

3.) Diesel Construction Equipment Age Requirements

To facilitate the application of verified Emission Control Devices, as well as provide lower baseline emissions, Tier 0-2 engines shall not be used in the performance of this Contract unless they have been upgraded to Tier 3 and then retrofitted with best available technology devices. As determined by the Engineer, exceptions will be made only for specific engines that are not readily upgraded to Tier 3, and where the Work of this Contract cannot reasonably be performed using alternative engines that comply with this Section. In such cases, the Contractor shall submit a written request for a waiver to the Engineer for review and approval prior to bringing such equipment onto the construction site.

4.) Diesel Engine Idling Policy

The idling time of non-road and on-road vehicles shall be limited to three (3) consecutive minutes as determined by the Engineer with the following exceptions:

a. An on-road or non-road vehicle is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control, or is in queue when engaged in an active operation with other equipment.

b. It is necessary to operate defrosting, heating, or cooling equipment to ensure the safety or health of the driver or passengers.

c. To ensure the safe and proper operation of auxiliary equipment that is located in or on the vehicle, to accomplish the intended use of the vehicle or equipment, but only to the extent so necessary (for example - cranes and concrete mixers).

d. To bring the vehicle to the manufacturer's recommended operating temperature, but only to the extent so necessary.

e. The outdoor ambient temperature is below twenty (20) degrees Fahrenheit.

f. A vehicle is being actively worked on for repairs or maintenance and engine idling is necessary to effectuate such repairs or maintenance.

5.) Electrification

Where electric power is distributed to and available throughout a construction site, electrically powered equipment shall be preferred over diesel-powered versions of that equipment.

C. Submittals:

The Contractor shall submit to the Engineer for review and approval an inventory list for all non-road diesel equipment and engines, and verified Emissions Control Devices. No Work shall commence utilizing diesel-powered non-road equipment rated at 50 hp or greater until the Contractor submits a comprehensive and complete inventory list inclusive of all such equipment, including the specifics of each as detailed below, and same is approved by the Engineer.

1.) The inventory list shall be provided in an electronic format (e.g., Microsoft Word, Access or Excel), and shall include the following:

a. Contract number and title.

b. Owner of equipment's name, address, telephone number and contact person familiar with the operation and maintenance of the equipment and the emission control technologies; whether owner is the Contractor, subcontractor or rental firm.

c. Dates that equipment is anticipated to arrive at and depart from the site.

d. Number, type, make, year of manufacture, manufacturer and serial number.

e. Engine type, tier level, make, horsepower rating, year of manufacture, and serial number.

f. Approximate fuel consumption rate per shift.

g. Anticipated function, duration of use, and days and hours of operation.

h. Retrofit type, make, model, manufacturer, installation date, EPA, VERT or CARB verification number or supporting documentation related to emission control devices.

i. Previous acceptance or waivers granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards.

2.) On-Going Equipment Updates:

Whenever a new or additional piece of diesel-powered non-road equipment is required to complete the Work of this Contract, the Contractor shall submit to the Engineer an update of the equipment inventory list. These updates shall include the actual dates the equipment arrives and departs from the site.

D. Waivers:

The Contractor shall submit a written request for a waiver to the Engineer for review and approval prior to bringing equipment that does not conform to the above requirements onto the construction site. The Contractor shall demonstrate due diligence by providing written documentation of efforts to comply with this Section. For waivers based upon the unavailability of retrofit devices for certain equipment, the Contractor will generally be required to provide written documentation from more than one vendor or supplier of retrofit devices to satisfy this requirement. Waiver requests related to the use of DPFs shall take into consideration actively regenerating filters for equipment with low temperature profiles that typically preclude the application of passively regenerating filtration systems.

Equipment retrofitted with an approved device in connection with another construction contract of the Authority, or the City of New York, or the Metropolitan Transportation Authority is exempt from further retrofitting for three (3) years from the date the retrofit was approved, even if new BAT retrofit devices are available. The Contractor shall submit to the Engineer documentation of approval of a retrofit device by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question. In addition, if the Authority, or the City of New York, or the Metropolitan Transportation Authority, another public agency that issued a waiver under the same or substantially the same standards previously waived a requirement contained in this Section for a particular piece of equipment, that equipment shall be exempt from the requirement for three (3) years from the date the initial waiver was granted.

1.) In responding to waiver requests, the following conditions will be taken into consideration with applicable documentation:

a. A BAT retrofit device would pose a safety hazard or impair operator visibility; or

b. A BAT retrofit device would void the engine warranty; or

c. A BAT retrofit device cannot be used for mechanical reasons; or

d. A BAT retrofit device or the engine would not function properly if the BAT retrofit device were installed; or

e. A Tier 0 engine is not readily upgraded to Tier 1, and where the task cannot be reasonably accomplished using alternative engines that do comply with this Section; or

f. The furnishing and installation of a BAT retrofit is more than 30 percent of the fair market value of the construction equipment; or

g. The Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards previously approved a BAT retrofit device for the equipment in question. Such approval is valid for three years from the date it was issued; or

h. The Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards previously granted a waiver for the equipment in question. Such waiver is valid for three years from the date it was issued.

In addition, the Engineer may, in his or her discretion, grant a waiver based upon excessive costs to satisfy the requirements of this Section, undue burden on the Contractor, marginal benefits, or other relevant factors, provided adequate supporting documentation is submitted by the Contractor.

2.) Waiver requests shall include the following:

a. Name of contractor applying for the waiver.

b. Contract number and title.

c. Owner of equipment's name, address, telephone number and contact person familiar with the operation and maintenance of the equipment and the emission control technologies, whether owner is the Contractor, subcontractor or rental firm.

d. Number, type, make, year of manufacture, manufacturer and serial number.

e. Engine type, make, horsepower rating, year of manufacture, and serial number.

f. Approximate fuel consumption rate per shift.

g. Anticipated function, duration of use, and days and hours of operation.

h. Technical explanation of safety hazard, mechanical constraint, warranty, limited availability, or functionality issues cited as basis for waiver.

i. Written documentation from retrofit device manufacturers, engine manufacturers, or rental companies, as appropriate, supporting the stated reasons for the waiver; for waivers based upon the unavailability of a retrofit device for specified equipment, the Contractor shall provide documents from more than one supplier.

j. If applicable, documentation of previous BAT retrofit approvals granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question.

k. If applicable, documentation of previous waivers granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question.

3.) Review of Waiver Application

The Engineer will make a determination whether to approve the Waiver Request no later than 10 days after its receipt.

102. NOISE CONTROL AND ABATEMENT

During the performance of Work at the construction site, the Contractor shall manage and control noise generated by construction activities in accordance with the criteria specified in this Section.

A. Acoustical Firm

The Contractor shall employ an acoustical firm to ensure compliance with the noise limits indicated herein and provide the services to develop and implement a Noise Control and Mitigation Plan (NCMP). The acoustical firm shall meet the following criteria:

1.) Member of one of the following

a. National Council of Acoustical Consultants

b. Association of Noise Consultants

2.) Demonstrate firm experience with noise measurement, monitoring and analysis for a minimum of three projects of similar size, complexity, and abatement initiatives within the preceding five years.

3.) The acoustical firm shall have a Noise Control Engineer (NCE) on staff or under contract. The NCE must either possess a baccalaureate in higher education from an accredited college or university in engineering, physics, acoustics or architecture; or be currently recognized as a full member or Board Certified member of the Institute of Noise Control Engineering (INCE). The NCE shall also have documented experience with construction noise analysis, and design of noise mitigation and control within the preceding five years.

4.) The acoustical firm shall have a Noise Control Officer (NCO) on staff or under contract. . The NCO shall have documented experience within the preceding five years in similar types of construction projects. The NCO shall complete training in community noise issues, standard methods for noise measurement and monitoring, and operation of all associated equipment and data collection. All NCOs must be trained by the NCE, or by an NCO with a minimum of three (3) years experience. The NCO shall possess a working knowledge of all applicable standards.

5.) Submit the following Acoustical Firm information to the Engineer:

a. Location and contact information.

b. Membership certificate with at least one of the associations listed in section A.1.

c. Documents proving firm project experience as required herein

d. Documents proving NCE and NCO experience, qualifications, and training as required herein.

B. Noise Control and Mitigation Plan (NCMP):

Submit to the Engineer, a written NCMP produced by the acoustical firm describing the means and methods for implementation by the Contractor to ensure compliance with the criteria specified herein. The NCMP shall specifically include, but not be limited to, the following:

1.) A scaled drawing of the construction site indicating contract name and number, legend of symbols, direction of North, and locations of noise sensitive receptors.

2.) A description of anticipated construction activities, phasing, and location of construction equipment during each phase.

3.) An inventory of construction equipment and associated noise levels.

4.) Calculated cumulative noise levels at sensitive receivers closest to each construction activity during worst-case construction phases utilizing the FHWA Roadway Construction Noise Model (RCNM) or equivalent model. Based on the construction schedule, all noise generating activities shall be included within each case and the cumulative A-weighted noise level (L_{eq}) shall be propagated to the nearest sensitive receiver for each Work area. Include all RCNM or equivalent model case files and detail mitigation means and methods assumed within the analysis. Based on the analysis, indicate sensitive receptors which will be exposed to noise levels that may exceed the noise criteria specified with all mitigation measures implemented.

5.) Update and resubmit the NCMP as requested by the Engineer and upon any major change in Work schedule, construction method, or equipment operation.

6.) Mitigation methods can include, but not limited to:

a. Use of electrical-powered equipment in lieu of diesel or gas-powered equipment

b. Use of hoppers, storage bins and dump trucks with noise reducing bed liners.

c. Use of broadband or strobe backup warning devices, or use backup observers in lieu of backup warning device for all mobile equipment. .

d. Use of physical barriers (shields/temporary noise barriers or curtains/acoustical blankets)

e. Use of exhaust mufflers, certified by the manufacturer, on all internal combustion engines.

f. Minimize idling times for vehicles to three (3) minutes.

g. Ensure Arrow Boards and Variable Message Signs (VMS) are solar powered during all hours of operation.

7.) When physical noise mitigation structures such as enclosures or barriers are required, submit to the Engineer all acoustical and structural capacity calculations, including wind load, in accordance with the Sections of Division 1 entitled "Shop Drawings, Catalog Cuts, and Samples" and "Temporary Structures. All design drawings of noise abatement structures shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey.

C. Noise Criteria

Perform the Work of this Contract to meet the noise requirements specified below:

1.) Anticipated construction noise levels must be included in the submitted Noise Mitigation Plan. If the anticipated noise levels exceed the noise levels within Tables 1 and 2, the Noise Mitigation Plan must include an explanation of why there will be an exceedance together with the noise mitigation measures considered.

2.) Drilling, blasting, and demolition activity is restricted to Monday to Friday 7:00 AM to 6:00 PM only, or as directed by the Engineer.

3.) The submitted NCMP must include specific measures to reduce noise of drilling, blasting, and demolition work in the event these activities are anticipated. This shall include use of best available quiet equipment technology and path control measures.

4.) All equipment to be used on the construction site shall meet the noise requirements of the New York City Local Law 113. At a minimum, equipment used shall not exceed the noise emission reference levels as indicated in the RCNM User's Guide. The Authority will verify compliance to the code and the RCNM for all equipment prior to implementation for production work. If a piece of equipment exceeds its allowable limit at any time during construction, the equipment will be removed from the site until properly mitigated.

Table 1 –Noise Limits at Sensitive Receptors – Monday to Friday 7:00 AM – 6:00 PM

Location	Maximum Allowable Noise Level (A-Weighted Slow Response)
Public right-of-way	85 dBA
Port Richmond High School and P.S. 21 Margaret Emery – Elm Park School	60 dBA

Table 2 – Noise Limits at Sensitive Receptors – All Other Times

Location	Time	10-min L_{eq} Noise Level Limits (A-Weighted Slow Response)
Area 1 (NJ)	Mon-Fri, 6:00PM – 11:00PM	71 dBA
	Mon-Fri, 11:00PM – 4:00AM	67 dBA
	Mon-Fri, 4:00AM – 7:00AM	73 dBA
	Weekends/Holidays, 8:00AM – 8:00PM	70 dBA
	Weekends/Holidays, 8:00PM – 8:00AM	67 dBA
Area 2 (NJ)	Mon-Fri, 6:00PM – 11:00PM	68 dBA
	Mon-Fri, 11:00PM – 4:00AM	64 dBA
	Mon-Fri, 4:00AM – 7:00AM	69 dBA

	Weekends/Holidays, 8:00AM – 8:00PM	67 dBA
	Weekends/Holidays, 8:00PM – 8:00AM	64 dBA
Area 3 (NY)	Mon-Fri, 6:00PM – 11:00PM	72 dBA
	Mon-Fri, 11:00PM – 4:00AM	67 dBA
	Mon-Fri, 4:00AM – 7:00AM	73 dBA
	Weekends/Holidays, 8:00AM – 8:00PM	72 dBA
	Weekends/Holidays, 8:00PM – 8:00AM	68 dBA
Area 4 (NY)	Mon-Fri, 6:00PM – 11:00PM	67 dBA
	Mon-Fri, 11:00PM – 4:00AM	63 dBA
	Mon-Fri, 4:00AM – 7:00AM	69 dBA
	Weekends/Holidays, 8:00AM – 8:00PM	66 dBA
	Weekends/Holidays, 8:00PM – 8:00AM	63 dBA
Area 5 (NY)	Mon-Fri, 6:00PM – 11:00PM	81 dBA
	Mon-Fri, 11:00PM – 4:00AM	76 dBA
	Mon-Fri, 4:00AM – 7:00AM	82 dBA
	Weekends/Holidays, 8:00AM – 8:00PM	81 dBA
	Weekends/Holidays, 8:00PM – 8:00AM	77 dBA

See Figure 1 for location of noise sensitive sites.

D. Noise Monitoring Equipment

1.) Furnish to the Engineer four (4) separate noise monitoring terminals (NMTs) capable of remote noise monitoring. The NMTs will be utilized by the Authority to ensure compliance with established limits. All NMTs comply with following:

a. Conform to the Type 1 (Precision) Sound Level Meter Standard as defined in the current revision of ANSI Standard S1.4-1983 "Specifications for Sound Level Meters".

b. Capable of measuring A-weighted noise levels (dBA L_{eq}) continuously, while operating on the "slow" response setting.

c. Capable of continuously data streaming 1-minute noise levels (dBA L_{eq}) and sending the data to a central computer through a 3G or better wireless modem.

d. Capable of simultaneously documenting noise levels as well as continuously recording audio files, which are saved and streamed to the central computer through a 3G or better wireless modem, once specific trigger levels have been exceeded.

e. Industry tested on at least one project for duration of at least one year.

f. Provide immediate notification when noise levels have exceeded limits, and of noise monitoring instrument failure.

g. The monitor, modem, batteries and all electronic components shall be enclosed within a protective weather resistant cabinet.

h. Outdoor microphone shall be fitted with a windscreen and bird spike assembly specifically designed for the outdoor microphone.

i. Prior to furnishing the equipment, the approval from the Engineer is required on the make and models of all components of the remote monitoring system.

j. Ancillary installation equipment including four (4) 1" diameter, 6' length galvanized threaded pipes and four (4) 3-outlet mini surge power strips.

k. Provide portable tablet-type personal computers for use by the Engineer to monitor noise at the construction site. The computer shall be Apple iPad2 or approved equal and have wireless internet access capability with access only to websites identified by the Engineer. The Contractor shall provide wireless internet service and maintenance for the computers for the duration of the Contract. The computers will be returned to the Contractor at the completion of work. Should the computers malfunction, the Contractor shall perform repairs as directed by the Engineer and be compensated at the Net Cost of such work

2.) NMTs shall be one of the following or approved equal:

Feature	Bruel & Kjaer	Norsonics
Noise Monitoring Terminal	3639-A-200	Nor 1530
Analyzer	2250	Nor 140 (Including 1408/5 Preamp and 1441 Extension Cable)
Outdoor Microphone	4952	Nor 1214
Software (Including Database Program)	7843-L	Nor 1022
Database	SQL Server	SQL Server
Audio	BZ-7844 Event Analysis and Sound Recording Option	Nor 140/08 Audio Recording Nor 140/16 Trigger Software
Computer	PC rack form factor according to manufacturers recommended requirements with uninterruptible power supply (UPS)	PC rack form factor according to manufacturers recommended requirements with uninterruptible power supply (UPS)
Modem	AC/DC Powered 3G Wireless	AC/DC Powered 3G Wireless

3) Install and relocate NMTS as directed by the Engineer in locations determined by the Engineer. Compensation for installation of the NMTs, removal and reinstallation of the NMTs for yearly calibration, furnishing, installation and removal of temporary NMTs and furnishing a 110 V three-pronged electrical receptacle, all as directed by the Engineer, will be at the Net Cost of such Work.

The Contractor is required to provide continuous AC power to the NMTs. This shall not be accomplished with a generator or any other means that will interfere with noise monitoring

103. DAILY PROGRESS, EQUIPMENT AND LABOR REPORTS

The Contractor shall furnish to the Engineer at the end of each day Work is performed at the construction site, a memorandum showing for that day (a) the construction performed, (b) the type of equipment used identifying each piece of equipment as owned by the Contractor or rented from others; (c) a statement of any unusual happening that occurred, and (d) the names and number of workers in each trade classification that were employed. Such memorandum shall not be deemed to be a substitute for the notices, time slips, memoranda or other data required under the clauses of the Form of Contract relating to compensation for Extra Work, nor shall such memorandum be deemed to be a substitute for the daily log required by the Section(s) of the Specifications pertaining to asbestos removal.

104. LAWS AND ORDINANCES

In order to effectuate the policy of the Authority, the Contractor shall comply with all provisions of federal, state, municipal, local and departmental laws, ordinances, rules, regulations and orders which would affect the Contract and the performance thereof and those engaged therein if said Contract were being performed for a private corporation, except where stricter requirements are contained in the pecifications or Contract Drawings, in which event the latter requirements shall apply. However, the Contractor shall not apply for any permits, licenses or variances in the name of or on behalf of the Authority, but shall do so in his own name where required by law, regulation or order or by the immediately preceding sentence. Nor shall the Contractor apply for any variance in his own name without first obtaining the approval of the Authority.

The Port Authority will coordinate approvals, and apply for the following permit(s) in connection with this Contract in its own name, unless noted otherwise:

1.) United States Coast Guard Bridge Permit

2.) United States Army Corps of Engineers Nationwide Permit 15

3.) Contractor shall apply for and obtain New York State Department of Environmental Conservation State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity

4.) Contractor shall apply for and obtain New York State Department of Environmental Conservation Stormwater Pollution Prevention Plan (SWPPP)

5.) New Jersey Department of Environmental Protection Waterfront Development (Coastal Zone Management) / Flood Hazard Individual Permit/ Water Quality Certificate

6.) New Jersey Department of Environmental Protection Construction Activity Stormwater General Permit

7.) New Jersey Department of Environmental Protection General Permit 5

8.) New Jersey Department of Environmental Protection New Jersey Pollutant Discharge Elimination System (NJPDES) Permit No. NJ0105023

9.) New Jersey Department of Transportation (NJDOT) Memorandum of Agreement: This agreement executed between the Authority and NJDOT shall serve as an NJDOT Major Access Permit, the Authority's Application for an NJDOT Drainage Permit, an NJDOT Highway Occupancy Permit or any other permit required from NJDOT, including FHWA Interstate Access approval, for the Authority to undertake the work on New Jersey State highways.

10.) Contractor shall apply for and obtain New Jersey Turnpike Authority Traffic Permit for installation of temporary construction signs. The Authority will obtain design and maintenance of traffic (MOT) approvals prior to the Contractor's application for the permit.

11.) New York City Department of Environmental Protection Site Connection Application Approval for the Storage Shed Sanitary Connection

12.) New York City Department of Environmental Protection Site Connection Application Approval for the Detention Pond Adjacent to Richmond Terrace

13.) New York City Department of Environmental Protection Internal Watermain Application Approval

14.) New York City Department of Environmental Protection Drainage Design Approval

15.) New York City Department of Environmental Protection Backflow Preventer Permit

16.) New York City Department of Environmental Protection Application for Registration - Internal Combustion Fuel Burning Equipment - Form AR 504

17.) New York City Department of Transportation Roadway/ Sidewalk Permit.

18.) Contractor shall apply for and obtain New York City Department of Transportation Crane Permit.

19.) New York City Transit Authority Bus Stop Temporary Relocation

20.) New York City Department of Parks and Recreation Tree Work Permit

21.) City of Bayonne Connection to City Storm Sewer/Water/Sanitary

22.) Contractor shall apply for and obtain City of Bayonne Roadway Construction Permit.

23.) City of Bayonne Police Department Roadway Occupancy Permission

24.) City of Bayonne New Jersey State Uniform Construction Code

25.) City of Bayonne Fire Department

26.) City of Bayonne Tree Permit

27.) City of Bayonne Noise Ordinance Variance

28.) Fire Department City of New York Approval

29.) Con Edison New Electrical Service Connection

30.) Public Service Enterprise Group New Electrical Service Connection

31.) Hudson, Essex, Passaic Soil Conservation District Soil Erosion and Sediment Control

32.) Contractor shall apply for and obtain New York State Department of Transportation Highway Work Permit for Utility Work and Highway Work Permit for Non-Utility Work. The Authority will obtain design and maintenance of traffic (MOT) approvals prior to the Contractor's application for the permits.

33.) Contractor shall apply for and obtain Hudson County Roadway Construction Permit. The Authority will obtain maintenance of traffic (MOT) approvals prior to the Contractor's application for the permit.

The Contractor shall comply with all provisions of the said permit(s).

105. U.S. COAST GUARD SECURITY REQUIREMENTS

The Contractor is advised that in conjunction with Port Security Provisions for the Port of New York and New Jersey a 25 yard security or exclusionary area has been established by the United States Coast Guard around all bridges, piers and other facilities on the waterfront in the Greater New York/New Jersey area. No person or vessel may enter these security areas without the approval of the Coast Guard Captain of the Port and Vessel Traffic Service Activities New York as well as the Commander, First Coast Guard District Bridge Branch.

All requests to enter into these security zones shall be made in writing to Captain of the Port of New York not less than 30 days prior to the intended date of entry into the zone. Requests must be submitted to the U.S. Coast Guard Waterways Oversight Branch at Commanding Officer, U.S. Coast Guard Activities New York (WOB), 212 Coast Guard Drive, Staten Island, NY 10305; (718) 354-4193 or 4355 and must contain a complete list of all personnel that will enter into the security zones, complete vessel information and, if appropriate, a copy of Coast Guard Bridge Branch construction approval.

The following information is required:

A. Employee's name, social security number and date of birth.

B. Contractor's supervisor name and telephone number.

C. Name, type, size of barge/vessel/boat.

D. Contract start and end dates, working hours and days.

After background checks of all personnel have been completed, Coast Guard Captain of the Port will issue a letter specifying personnel and vessels authorized to enter the security zone.

After initial written approval for entry has been received, the Contractor shall notify the Coast Guard (Vessel Traffic Service 718-354-4088) daily prior to entering and upon securing for the day or leaving the site.

If additional, or changes in existing personnel, are required said information identified above shall be transmitted as above, as early as possible, but not less than 96 hours in advance of the expected change.

Failure to comply with the above Security Zone Requirements and Conditions is punishable under Federal Law by arrest, prosecution, and or civil penalties.

106. SIGNS

No advertisement or sign, other than the name and address of the Contractor, will be permitted on any fences, temporary structures or elsewhere on the construction site and such advertisement will be permitted only upon the condition that it is first approved by the Engineer. In any event, the advertisement shall not exceed six feet by eight feet in overall dimensions.

107. CONTRACTOR'S FIELD OFFICE AND REPRESENTATIVE

At a readily accessible point on or near the construction site, the Contractor shall maintain a field office provided with a telephone.

During the performance of any Work at the construction site, the Contractor shall have a representative thereat who shall be authorized by the Contractor to receive and put into effect promptly all orders, directions and instructions from the Engineer. The Contractor's representative shall be provided, at all times, with a conformed copy of this Contract and a set of the Contract Drawings.

Orders and directions may be given orally by the Engineer and shall be received and promptly obeyed by the Contractor or his representative or any superintendent, foreman or other employee of the Contractor who may have charge of the particular part of the Work in relation to which the orders or directions are given. A confirmation in writing of such orders or directions will be given by the Engineer when so requested by the Contractor.

108. SURVEYS

The Engineer will establish a bench mark and a base line at or adjacent to the location of the Contractor's operations. The Contractor shall perform all surveys which may be required for the performance of the Contract. He shall carefully preserve any base line and bench mark which may be established by the Engineer.

The Contractor shall, in addition, furnish to the Engineer, without additional compensation therefor, any or all information and data regarding points, lines, grades, elevations and other survey information established by the Contractor during the performance of the Contract.

Surveys and measurements of quantities for purposes of computing Contractor's compensation shall be made by the Contractor as directed by and in the presence of, or jointly with, the Engineer, at the Engineer's option. Computations of quantities for payment shall be made by the Contractor and shall be subject to the approval of the Engineer.

109. TEMPORARY STRUCTURES

Unless otherwise provided in this Contract, the Contractor shall determine the need for and shall design, furnish and construct all barricades, fences, staging, falsework, formwork, shoring, scaffolding and other temporary structures required in the performance of the Contract, whether or not of the type enumerated in the Specifications or on the Contract Drawings, including those which would be required by law or regulation if this Contract were being performed for a private corporation. All such temporary structures shall be of adequate strength for the purposes for which they are constructed and shall be provided with graphics, warning signs and warning lights as required to inform personnel and the public of the hazards being protected against, and the Contractor shall maintain them in satisfactory condition. The design and drawings for such structures shall be prepared by the Contractor utilizing a professional engineer licensed in the state where the structure will be constructed, and when requested by the Engineer they shall be submitted for his review before being used.

The Contractor shall ensure that each temporary structure is inspected by the professional engineer who designed the temporary structure prior to initial use and submit a schedule of periodic inspections to be performed by such professional engineer to the Engineer for review. The number of periodic inspections of temporary structures to be performed by the professional engineer shall be the minimum required by law or regulation if this Contract were being performed for a private corporation. The Contractor shall also submit a signed and sealed statement of inspection from the professional engineer performing the inspection of the temporary structure, including a statement of fitness for use for the intended purpose of the temporary structure, to the Engineer for review.

Neither such approval, however, nor any requirements of the Engineer, the Specifications or the Contract Drawings shall relieve the Contractor of his responsibility for the design, construction and use of the temporary structures or from any obligations and risks imposed on him under this Contract, and any such approval or requirements shall be deemed merely to relate to minimum standards and not to indicate that the temporary structures are adequate or that they meet the Contractor's obligations under this Contract.

Temporary structures shall be painted with an approved dark color paint and shall be repainted whenever necessary during the period that the Contract is being performed. Upon completion of all Work under this Contract, the temporary structures shall be removed from the construction site.

110. PERMIT AND REQUIREMENTS FOR WELDING

Prior to the commencement of any cutting or welding operations at the construction site, the Contractor shall notify the Engineer and obtain an Authority cutting and welding permit. The Authority will issue this permit without payment of a fee, and application forms may be obtained from any Resident Engineer of the Authority, at his office at the facility. Unless otherwise approved by the Engineer, all cutting and welding operations shall be performed in accordance with the conditions which form a part of said permit. The permit application must be filled out and submitted in duplicate to the Engineer at least forty-eight hours prior to commencing welding or cutting operations at the construction site.

111. FINAL INSPECTION

When, in the opinion of the Contractor, the construction is completed and ready for final inspection, he shall so notify the Engineer in writing and the Engineer will give said construction (including any portions with respect to which Certificates of Partial Completion have been issued) a minute and thorough inspection. Before any Certificate of Final Completion will be issued, any defects or omissions noted on this inspection must be corrected by the Contractor.

112. WARRANTIES

The Specifications may provide for certain warranties of portions of the permanent construction. These warranties are intended for the greater assurance of the Authority and not as a substitute for rights which the Authority might otherwise have. Although such warranties shall be enforceable as provided, neither any requirement of this Contract with respect to warranties by the Contractor nor any guarantee or warranty given to the Contractor or the Authority by any manufacturer shall be deemed to be a limitation upon any rights which the Authority would have, either expressed or implied, in the absence of such guarantees or warranties.

113. UTILITY DATA COLLECTION

In order to assist the Authority with the collection of as-built utility data, notify the Engineer within 48 hours prior to the covering of all underground structures, piping, conduit, cable or duct banks.

Do not build-in, backfill, fill over, around, or in any way cover underground structures, piping, conduit, cable or duct banks until given notice to proceed by the Engineer.

Nothing contained herein shall relieve the Contractor from performing the Work in accordance with the Contract Drawings and Specifications nor release the Contractor from any obligations under or upon this Contract.

114. REQUIREMENTS FOR CRANES AND DERRICKS

During the performance of Work at the construction site, the use by the Contractor or his subcontractors of power operated cranes and derricks for hoisting and/or rigging purposes; or for construction, alteration, demolition, excavation and maintenance purposes, including highways or sewers; or for the installation of piles; or for the hoisting or lowering of any article on the outside of any building or structure shall be subject to the approval of the Engineer in accordance with this Section.

A. Determinations will be made in writing by the Engineer on whether cranes and other such equipment meeting certain criteria shall be exempt from all or part of the requirements herein. Such determinations shall in no way relieve the Contractor from conformance with all applicable requirements of this Section and governing codes including the possession of a valid operator's license (NCCCO- National Commission for the Certification of Crane Operators license) subject to verification by the Engineer.

1.) The following equipment will be considered for full exemption, which means exempt from B., C., D., E., F., G., and H. below:

a. Excavating or earth-moving equipment, except cranes used with clamshells.

b. Augers, churn-drills, and other drilling equipment not used for the hoisting of any objects.

c. Mobile cranes, including jibs and any other extensions to the boom, exceeding 50 feet but not exceeding 135 feet in length, and with a manufacturer's rated capacity of 3 tons or less used exclusively as a man-basket.

d. Hoisting machines permanently mounted on the bed of material delivery trucks that are used exclusively for the loading and unloading of such trucks, provided that the length of boom does not exceed the length of the truck bed by more than 5 feet, and any material transported thereon shall not be raised more than 2 feet in the unloading process.

e. Cranes and derricks with a manufacturer's rated capacity of less than 1 ton.

f. Mechanics trucks with a hoisting device used in activities associated with the *maintenance and repair of construction related equipment.*

g. Articulating boom cranes that do not have an integral hoisting mechanism and that are used exclusively for the loading and unloading of trucks or trailers, provided that the length of boom does not exceed 135 feet, and that any material transported thereon shall not be raised more than 100 feet in the unloading process.

2.) The following equipment will be considered for Partial Exemption – I, which means exempt from B.4.), C.2.), C.4.) and D. below:

a. Cranes with less than 160 feet combined boom/jib length to be used for a period not exceeding 24 hours, operated entirely within Authority property and at a location at least one boom/jib length away from all Authority property.

b. Service cranes and clamshells with a boom length of 110 feet or less, to be operated entirely within Authority property and at a location that does not require the moving of any load over a roadway or sidewalk.

c. Pile drivers or clamshells operated entirely within Authority property with a soil bearing pressure not exceeding 500 pounds per square foot.

d. Mobile cranes, including jibs and any other extensions to the boom, not exceeding 50 feet in length and with a manufacturer's rated capacity of 3 tons or less.

3.) The following equipment will be considered for Partial Exemption – II, which means exempt from B., C. 2.), C. 3.), C. 4.), D., F., and G. below:

a. Articulating/knuckle boom cranes used to hold, support or stabilize material to facilitate construction activity.

b. Cranes with a manufacturer's rated capacity of 1 ton or more.

B. For each crane or derrick not considered fully exempt by the Engineer, submit the following forms to the Engineer prior to delivery of the crane or derrick to the construction site:

1.)

a. For Work performed in New York City: A copy of a current and valid Form CD-2, entitled "Crane/Derrick/Mobile Work Platform – Approval and Operation Application/Certificate", Revised 08/15/05, as issued by the New York City Department of Buildings - Cranes & Derricks Division, hereinafter called "NYCDOB-C&D". Form CD-2 shall bear the approval stamp of NYCDOB-C&D as a "Temporary Certificate of Approval/Temporary Certificate of Operation," and shall include an expiration date, a legible CD Number, and an authorized signature from a representative of NYCDOB-C&D. In the event that such approved Form CD-2 is not available, the Contractor shall ensure that the owner of the crane or derrick files a Form CD-2 directly with NYCDOB-C&D. Submit to the Engineer proof of the filing, a copy of the completed Form CD-2, and an "acceptable to operate" inspection report issued by NYCDOB-C&D.

b. For Work performed outside of New York City: A copy of a current and valid Form NYCDOB CD-2 or a crane inspection report including the items listed in E. 5.) below. The crane inspection shall be performed by an inspector meeting the following requirements:

(i) Five years experience in the hoist and rigging industry

(ii) Nationally certified as inspector for mobile, tower, rigging and safety

(iii) Manufacturers' specific training on crane equipment

2.)

a. For Work performed in New York City: A fully executed Form CD-11, entitled "Equipment Owner Identification Form", Revised 12/03, as issued by NYCDOB-C&D.

b. For Work performed outside of New York City: A fully executed Form NYCDOB CD-11 or statement of ownership on letterhead from the crane owner.

3.) For Work performed in New York City: A fully executed Form CD-16, Statement of Notification to Community Boards.

4.)

a. For Work performed in New York City: A fully executed Form CD-4, entitled "Crane/Derrick/Mobile Work Platform – On-Site Inspection Application/Certificate", Revised 12/03, as issued by NYCDOB-C&D. Form CD-4 shall be accompanied by drawings and calculations, all signed and sealed by a Professional Engineer licensed in the state of New York. The drawings and calculations shall clearly indicate the following:

(i) Location of each crane or derrick.

(ii) All pertinent features of the site.

(iii) Supporting platforms and structures.

(iv) Swing and reach of each crane or derrick.

(v) Calculations showing an acceptable factor of safety for overturning for any loading condition.

(vi) If either prestressed or non-prestressed soil or rock anchors are required to provide an acceptable factor of safety for overturning:

(a.) The calculations shall include the design for the tie-downs prepared.

(b.) The drawings shall include the installation and testing requirements for the tie-downs.

(c.) The testing of the tie-downs shall be witnessed by the Professional Engineer that prepared the tie-down design. At the completion of the testing, submit a tie-down load test report verifying the capacity of the tie-downs.

(vii) Calculations showing that the maximum bearing pressure for the crane under any loading condition is less than the allowable bearing pressure for the soil.

(viii) Calculations showing that the maximum bearing pressure for the crane under any loading condition does not overstress any subsurface utility, structure, or retaining wall.

b. For Work performed outside New York City: A fully executed Form NYCDOB CD-4 or a letter signed and sealed by a Professional Engineer licensed in the state where the Work is being performed explaining intent of crane use, designating crane safety coordinator and equipment user and stating that equipment will not be used unless an on-site inspection is performed; such letter shall be accompanied by drawings and calculations as specified in (i) through (viii) above, all signed and sealed by a Professional Engineer licensed in the state where the Work is being performed.

5.) If the crane or derrick location is within two hundred feet (200') of an NYC subway line or facility, approval from New York City Transit ("NYCTA") is required prior to the placement, assembly, or erection of the crane or derrick. In such cases, a Certificate of On-Site Inspection cannot be issued without NYCTA written approval.

C. .Upon the review and acceptance in writing by the Engineer of all of the above submissions, the crane or derrick will be permitted to enter the construction site. Coordinate all such deliveries with the Engineer.

D. Upon delivery to the construction site for cranes or derricks considered for Full Exemption or Partial Exemption – I or Partial Exemption – II by the Engineer, submit the following to the Engineer in accordance with A. above. For all other cranes or derricks, submit all of the following to the Engineer:

1.) Names, classifications, and license numbers of each crane or derrick operator and the master, tower, or climber crane rigger.

2.) For cranes or derricks to be operated solely on Authority property:

a. For Work performed in New York City: Form CD-8, entitled "Technical Report – Statement of Responsibility", Revised 12/03, as issued by the NYCDOB-C&D. Form CD-8 shall be completed in its entirety with the exception of Box #5B, and signed and sealed by a Professional Engineer licensed in the state of New York in Box #5A.

b. For Work performed outside of New York City: Form NYCDOB CD-8 or a letter from a Professional Engineer licensed in the state where the Work is being performed stating responsibility for the design of the foundation.

3.) Upon review and acceptance by the Engineer of all submitted drawings and associated documentation specified above, the Contractor will be permitted to place and/or assemble the crane or derrick at the construction site, with the exception of tower or climber cranes. For tower or climber cranes, additional submittals and inspections shall be required as specified in 4.) below.

4.) For cranes or derricks to be operated on other than Authority property:

a. For Work performed in New York City: File all forms, drawings and associated documentation directly with NYCDOB-C&D. Upon the submission to the Engineer of a current and valid "Certificate of On-Site Inspection" as issued by NYCDOB-C&D, will the Contractor be permitted to assemble or erect the crane or derrick at the construction site.

b. For Work performed outside New York City: File directly with the local municipality and submit proof of such municipality approval to the Engineer prior to erecting the crane or derrick at the construction site.

5.) For tower or climber cranes, in addition to the documentation in B. and C. above, submit the following to the Engineer:

a.

(i) For Work performed in New York City: A fully executed Form CD-7, entitled "Notification of Erecting or Dismantling of Climber or Tower Crane", Revised 07/07. Form CD-7 shall be accompanied by a copy of the license of each master or tower rigger designated to supervise the erection of the crane and all associated documentation required to ensure compliance with the manufacturer's recommendations. Form CD-7 shall also be accompanied by signed and sealed drawings by a Professional Engineer licensed in the state of New York for the erection, jumping, climbing and dismantling of the tower or climber crane. Documentation and drawings shall include the following:

(a.) Serial number identification of equipment to be used for all rigging and lifting operations including all machines to be used for erection or dismantling.

(b.) Detailed listing of assemblies and components required for erection and dismantling of rigging and lifting equipment, including but not limited to lifting frame, climbing hydraulic cylinders, upper basket, lower basket, outriggers, communication system, tie-downs, dogs, horn, lights and weathervane.

(c.) Location of rigging and lifting equipment; assist cranes, sidewalk sheds, surrounding buildings, protection for their roofs and pick-up points, loads, and radius of swing of all loads. In addition, submit to the Engineer the safe load from the crane manufacturer's approved load radius chart for lift radius.

(d.) Weight list certified by the crane manufacturer listing all assemblies and components to be lifted. All components shall be clearly marked with their weight painted on the assembly, or stamped on metal tags attached to the assembly. In lieu of an equipment manufacturer's certification, submit documentation signed and sealed by a Professional Engineer licensed in the state of New York certifying the weight list and indicating how such weights were determined.

(e.) Locations of the centers of gravity for all asymmetrical components.

(f.) Sequence of operation detailing erection, jumping, climbing and dismantling, along with the rigging materials to be used in such operations.

(g.) Written certification by a Professional Engineer licensed in the state of New York that all safety devices on each crane to be used in the erection, jumping, climbing and dismantling operations have been calibrated in accordance with the crane manufacturer's recommendations.

(h.) Names, license numbers (as applicable) and contact information for each licensed rigger, rigger foreman, site safety manager, crane safety coordinator and entity performing the erection, jumping, climbing, and/or dismantling Work.

(i.) Load test procedure signed and sealed by a Professional Engineer licensed in the state of New York identifying the weights to be used and the load moment and line pull testing to be conducted in accordance with b. below.

(ii) For Work performed outside New York City: A fully executed Form NYCDOB CD-7 or a letter from a Professional Engineer licensed in the state where the Work is being performed documenting the date of the erection/jump/lowering or dismantling of a climber or tower crane. Such letter shall include rigger's information and equipment user stating responsibility and conforming to manufacturer's procedures and be accompanied by documentation and drawings listed in (a.) through (i.) above.

b. A load test shall be conducted on each tower or climbing crane by a Professional Engineer licensed in the state where the Work is being performed in accordance with the load test procedure submitted under (i.) above. Upon completion of the load test and determination that the results are satisfactory, submit to the Engineer the signed and sealed report certifying acceptance of the results by the Professional Engineer licensed in the state where the Work is being performed.

c.

(i) For Work performed in New York City: A fully executed Form CD-12, entitled "Designation of Safety Coordinator" Revised 12/03, as issued by NYCDOB-C&D.

(ii) For Work performed outside New York City: A fully executed Form NYCDOB CD-12 or a letter designating the name of the Designated Safety Coordinator for the crane and stating responsibility for the control of pedestrian and vehicular traffic in the hoisting area.

d. A signed and sealed report documenting the results of the field inspection of the crane in the "unassembled state (for cranes delivered in the unassembled state)" performed by a Professional Engineer licensed in the state of where the Work is being performed and certifying that all crane parts are in satisfactory condition, and acceptable for assembly and erection.

e.

(i) For Work performed in New York City: A copy of the Safety Coordination Meeting Log as stipulated in Section BC 3319 entitled "Cranes and Derricks" of the Building Code for the City of New York (BCCNY) (3319.8.2 through 3319.8.8, and 3319.10.2). Conduct the safety coordination meeting within the week prior to the erection, jumping, climbing, or dismantling of a tower or climber crane in accordance with BCCNY and notify the Engineer one week prior to the meeting.

(ii) For Work performed outside New York City: Conduct a safety coordination meeting within the week prior to the erection, jumping, climbing, or dismantling of a tower or climber crane, notify the Engineer one week prior to the meeting and submit a copy of the safety coordination meeting log along with the rigging crews' licenses.

(iii) Upon review and acceptance by the Engineer of all documentation in B. and C. above, the Contractor will be permitted to erect the tower or climber crane at the construction site.

E. Prior to the use and/or operation of each crane or derrick, including tower or climber cranes, at the construction site when the crane or derrick will be operated solely on Authority property, complete the following:

1.)

a. For Work performed in New York City: Performance of a field inspection of the crane or derrick in the "assembled state" by a Professional Engineer licensed in the state of New York in accordance with BCCNY Reference Standard RS 19-2 including the verification, inspection, and certification of the following:

(i) That the crane or derrick has a current and valid Form CD-2 as issued by NYCDOB-C&D for the configuration to be used at the construction site.

(ii) That the support, dunnage, configuration and location of the crane or derrick have been constructed and positioned in accordance with the drawings and calculations submitted to the Engineer with Form CD-4.

(iii) That the crane or derrick is in working order and there is no visible damage including, but not limited to, the following items:

(a.) Bent or missing lacings

(b.) Pins are properly installed and have no visible fatigue

(c.) Maladjustment of control mechanisms interfering with proper operation

(d.) Excessive wear of control mechanisms components and contamination by lubricants or other foreign matter

(e.) Malfunction of operational aids

(f.) Hydraulic hoses

(g.) Deformation, chemical damage, cracks and wear of hooks and latches

(h.) Rope reeving for compliance with crane manufacturer's specifications

(i.) Malfunction and excessive deterioration of electrical apparatus and accumulation of dirt and moisture

(j.) Hydraulic system for proper oil level

(k.) Tires for recommended inflation pressure

Upon the completion of the field inspection and the determination that the crane or derrick is sound and has been assembled and positioned in accordance with the drawings and calculations submitted to the Engineer with Forms CD-4 and CD-7, submit to the Engineer both a signed and sealed inspection report certifying conformance by the Professional Engineer licensed in the state of New York and a fully executed Form CD-8, signed and sealed in Box #5B.

b. For Work performed outside New York City: A Professional Engineer licensed in the state where the Work is being performed shall perform a field inspection of the crane or derrick in the "assembled state" including the verification, inspection, and certification of the following:

(i) That the crane or derrick has a current and valid inspection report in accordance with B. 1.) above

(ii) That the support, dunnage, configuration and location of the crane or derrick have been constructed and positioned in accordance with the drawings and calculations submitted with the letter outlining the intended use of the crane.

(iii) That the crane or derrick is in working order and there is no visible damage including, but not limited to, the items listed in D. 1. a. (iii) above.

(iv) Submit a letter to the Engineer stating that the Professional Engineer licensed in the state where the Work is being performed has completed the foundation inspection, the foundation conforms to the approved drawings and there are no hazardous conditions.

2.) For tower or climber cranes, in addition to the above, perform the following:

a. For performance of Work in New York City: Procure the services of a land surveyor licensed in the state of New York to perform a plumbness survey, a licensed testing laboratory to perform anchor bolt pull-out testing, and a licensed rigger to certify compliance with the manufacturers bolt torque values connecting sections. Submit to the Engineer a fully executed Form CD-6, entitled "Crane / Derrick and Work Platform – Plumbness And Torque Notification/Anchor Bolt Pull Out Test" Revised 12/03, as issued by NYCDOB-C&D.

b. For performance of Work outside New York City: Submit to the Engineer a fully executed Form NYCDOB CD-6 or procure the services of a land surveyor licensed in the state where the Work is being performed to perform a plumbness survey, a licensed testing laboratory to perform anchor bolt pull-out testing, and a licensed rigger to certify compliance with the manufacturers bolt torque values connecting sections.

Upon the review and acceptance by the Engineer of all documents required above, the Contractor will be permitted to use and operate the crane or derrick at the construction site.

F. Requirements for inspection and operation of cranes at the construction site:

1.) Monthly inspections and reports shall be performed, prepared and signed by a competent person as defined in Federal Register Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926 Cranes and Derricks in Construction; Final Rule (OSHA), and a copy of each inspection report shall be store in the crane cab for three months.

2.) Pre-lift meetings shall be held as outlined in Federal Register Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926 Cranes and Derricks in Construction; Final Rule (OSHA). Submit pre-lift meeting minutes to the Engineer.

3.) No crane or derrick operator shall start an operation when the wind speed exceeds 30 miles per hour or the wind speed is forecast to reach 30 miles per hour before the operation can be completed. Tower cranes shall not be raised to new operating levels when the wind speed exceeds 20 miles per hour.

4.) All mobile cranes with 120' of boom or larger and /or 220 ton capacity or greater and all tower cranes operated at the construction site shall be equipped with a load data recorder for crane lifts.

5.) Inspections of cranes shall include the following:

a. Historical information and maintenance

b. Mainframe member

c. Upper power plant smoke

d. Upper rotating structure

(i) Turntable

(ii) Pumps/motors/valves/lines/tubes

(iii) Ring gear/pinion gear/rollers

(iv) Main hoist and rope

(v) Auxiliary hoist and rope

(vi) Boom hoist and rope

(vii) Luffing boom hoist and rope

e. Lattice boom

f. Telescoping boom

g. Wire rope/Block/Ball

h. General

(i) Metals

(ii) Covers/guard

(iii) Lights

(iv) Housekeeping

(v) Safety/warning decals and labels

(vi) Hand signal chart

(vii) Paint condition/corrosion control

i. Driver cab

(i) Cab grab rails/steps

(ii) Cab glass

(iii) Windshield wipers

(iv) Cab doors/restraints

(v) Mirrors

(vi) Fire extinguisher

(vii) Seats/restraints

(viii) Seat belt

(ix) Parking brake

(x) Air pressure

(xi) Controls identification

(xii) Instruments/gauges

(xiii) Electrical switches/functions

(xiv) Horn

(xv) Lights

(xvi) Steering

(xvii) Engine clutch

(xviii) Accelerator

(xix) Brake

j. Carrier power plant lower guards exhaust/insulators

(i) Belt/hoses

(ii) Rotation

k. Carrier

(i) Transmission

(ii) Drive line

(iii) Tire/air pressure/wheels

(iv) Main frame members

(v) Hydraulic hoses/tubing/fitting

(vi) Hydraulic fluid levels

(vii) Anti skid surface

(viii) Front bumper counterweight

(ix) Back up alarm

l. Outrigger boxes/beams

(i) Outrigger cylinders/floats/pads

(ii) Hydraulic hoses/tubes/fittings

(iii) Holding valve

(iv) Position locks

(v) Warning signs

(vi) Blocking/cribbing

m. Crawler assembly

(i) Car body/side frames

(ii) Chain/condition adjustment

(iii) Sprockets/idlers/rollers

(iv) Track pad/pins

(v) Travel locks

(vi) Steering clutches

n. Operator cab and station

o. Load chart-secure/visible from operator

p. Safety devices/operational aids

(i) Warning decals

(ii) Boom angle indicator

(iii) Main drum rotation indicator

(iv) Auxiliary drum rotation indicator

(v) Load moment indicator

(vi) Load weight indicator

(vii) Radius indicator

(viii) Crane level indicator

(ix) Anti-two block device

(x) Two block warning device

(xi) Boom hoist shut off

(xii) Boom hoist ratchet and pawl

(xiii) Tower Crane - lower hoist limit device

(xiv) Tower Crane - trolley limit device

(xv) Tower Crane -wind velocity device

(xvi) Tower Crane - weathervaning

(xvii) Tower Crane - aircraft strobe light

q. Power plant upper

(i) Performance/exhaust system guards and insulators

(ii) Belts/hoses

(iii) Guard cover/rotating and reciprocating parts

r. Rotating upper structure

(i) Turntable/ bearing/rollers/roller path

(ii) Ring gear/pinion gear

(iii) Hydraulic pumps/pressure

(iv) Electric wiring

(v) Main hoist clutches/ brakes

(vi) Main hoist wrapping on the drum/ min. rope wraps

(vii) Auxiliary hoist clutches/ brakes

(viii) Auxiliary hoist wrapping on the drum/ min. rope wraps

(ix) Boom hoist clutches/ brakes

(x) Boom hoist wrapping on the drum/ min. rope wraps

(xi) Swing system/assembly

(xii) Hydraulic motor/valve/line

(xiii) Drums/flanges

(xiv) Clutch/brake protection

(xv) Torque converter

(xvi) Anti skid surface

(xvii) Steps/handholds/platforms

(xviii) Access to cab

(xix) Air system - compressor/line

(xx) Counterweight frame and mounting/warning signs

(xxi) Electrocution warning signs

s. Boom support system

(i) Gantry/mast

(ii) Boom stops

(iii) Inner bail

(iv) Outer bail/equalizer

(v) Sheaves

(vi) Boom hoist reeving

t. Lattice boom

(i) Boom section identification

(ii) Boom section sequence

(iii) Boom section alignment

(iv) Warning decals

(v) Spreader bar

(vi) Sheaves

(vii) Hoist line dead end

(viii) Wire rope retainer

(ix) Boom foot pins/keepers

(x) Boom head section

(xi) Auxiliary boom head

(xii) Lattice member

(xiii) Cord member

(xiv) End connections/pins

u. Lattice jib

(i) Positive stops

(ii) Sheaves

(iii) Wire rope retainer

(iv) Lattice member

(v) Cord member

(vi) End connections/pin

(vii) Tower crane - jib section / insert identification

(viii) Tower crane - jib foot pins/keepers

(ix) Tower crane - jib head/heel sections

(x) Tower crane -auxiliary head/heel sections

v. Telescopic boom

(i) Lift cylinders

(ii) Telescoping cylinders

(iii) Hydraulic hoses/tubing fittings

(iv) Holding devices

(v) Boom section alignment

(vi) Wear pads

(vii) Equal extensions

(viii) Sheaves

(ix) Structure/welds

(x) Boom hinge pin

(xi) Boom head section

(xii) Wire rope retainer

w. Solid jib extension manual sections

(i) Alignment

(ii) Locking devices

(iii) Structure/welds

x. Wire rope

(i) Boom hoist-size/construction/damage/lubricant

(ii) Main hoist-size/construction/damage/lubricant

(iii) Auxiliary hoist-size/construction/damage/lubricant

(iv) Jib pendants-size/construction/damage/lubricant

(v) Boom pendants-size/construction/damage/lubricant

y. Ball and hook

(i) Main weight/capacity/sheaves/safety latches/wear twist and throat/bearing and swivel

(ii) Wedge socket end fitting/Non-destructive testing

(iii) Auxiliary weight/capacity/sheaves/safety latches/wear twist and throat/bearing and swivel

(iv) Wedge socket end fitting/Non-destructive testing

(v) Boom pieces list and length

(vi) Jib pieces list and length

z. Tower crane-ties and supports

(i) Slab tie-in

(ii) Collars/wedges/tie-ins/attachments

(iii) Tie-in bolts

(iv) Structural base

G. If the inspection date expires while the crane or derrick is in use at the construction site on Authority property, the Contractor shall ensure that the owner of the crane or derrick files all renewals and/or extensions. Submit proof of the filing along with a copy of the completed inspection to the Engineer. Upon receipt of any such renewals or extensions, submit copies to the Engineer.

H. The estimated review time for all crane and derrick submissions to the Engineer is five (5) business days. If the Contractor has not received any reply by the fourth day of the review, contact the Engineer.

I. If any governing agency issues a letter of deficiency to the Authority or stop work order to the Contractor while the crane or derrick is on Authority property, the Contractor shall cooperate fully with all governing agencies to ensure that all acceptable corrective actions will be taken immediately. Keep the Engineer advised during the performance of all remedial Work.

115. TEMPORARY UTILITY SERVICES

Operate and maintain temporary services and facilities in a safe and efficient manner. Modify as required throughout progress of the Contract, and remove from Authority property when no longer required, or replaced by the use of completed permanent facilities as approved by the Engineer.

Heat is not available at the construction site. Provide temporary heat as required to maintain environmental conditions to facilitate progress of the Work and to protect materials and finishes from damage due to temperature and humidity. Temporary heating units shall be vented self-contained units with individual space thermostatic control, shall be UL tested and approved for the fuel being consumed, shall be installed in accordance with ANSI A10.10 "Safety Requirements for Temporary and Portable Space Heating Devices and Equipment Used in the Construction Industry", and shall be approved by the Engineer. Use of gasoline burning space heaters, open flame, or salamander type heating units is prohibited. The Contractor shall pay costs of installation, maintenance, operation, removal and for fuel consumed.

Electricity is not available at the construction site. Provide electricity for construction purposes and artificial light by use of portable generator(s) or arrangement with the local utility company. The Contractor shall pay all costs of installation, maintenance, operation, removal and for service and power used.

Water for construction purposes is available at the construction site, subject to such conditions and precautions upon its use as may be imposed by the Engineer. The Authority will pay the cost for water used. Provide connections to existing facilities, and extend with branch piping, taps and hoses as required. Protect piping and fittings against freezing. The Contractor shall pay all costs of installation, maintenance, operation and removal for temporary service connections.

116. TEMPORARY SANITARY FACILITIES

Make arrangements for securing and pay all costs for temporary toilets, wash facilities and drinking water including toilet tissue, paper towels, paper cups and similar disposable materials for use by the Contractor, subcontractors, materialmen or other persons over whom the Contractor has control. Comply with regulations and health codes, which would be applicable if the Authority were a private corporation, for the type, number, location, operation and maintenance of fixtures and facilities. Install facilities where directed by the Engineer, and remove from Authority property when no longer required.

117. ASBESTOS COST SUMMARY SUBMITTAL

Upon satisfactory completion of asbestos removal Work under this Contract, submit a Summary of Asbestos Removal and Disposal Costs on the form bound herewith, with all spaces filled in without exception. Such summary shall include costs associated with the Work computed in accordance with the stipulations of the clauses contained in CHAPTER II of the Form of Contract.

For purposes of completing such Summary of Asbestos Removal and Disposal Costs, the specific locations of asbestos removal and disposal are:

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
SUMMARY OF ASBESTOS REMOVAL AND DISPOSAL COSTS
(FOR COMPLETED WORK)

CONTRACTOR _____ CONTRACT NO. AKB-264.039
DATE _____
FACILITY TITLE: BAYONNE BRIDGE
SPECIFIC LOCATION OF REMOVAL _____

	ASBESTOS CONTAINING MATERIALS[34]		
ITEM DESCRIPTION	Sprayed-on[35]	Pipe and Boiler Insulation[36]	Miscellaneous[37]
Removal[38]			
Encapsulation[39]			
Enclosures [40]			
Insurance[41]			
Replacement of Removed ACM[42]			
Clean up[43]			
On-site Monitoring of Abatement[44]			
Disposal of ACM[45]			
Purchase of Capital Equipment[46]			
Purchase of Protective Equipment[47]			
TOTALS:			

34 Where a particular type of asbestos containing material (ACM) is not present in the specific removal location described above, cross out ACM description and fill in NA (Not Applicable) for the associated description items.

35 Sprayed-on and trowelled-on fireproofing, acoustical plasters, simulated acoustical plasters, textures and other ACM such as those found on ceiling systems, fireproofing systems and structural steel.

36 Insulation or treatment on pipes, fittings, elbows, boilers, breachings, ducts, tanks or other mechanical equipment.

37 Specify as to type of material, i.e.; surface treatments such as floor and ceiling tiles, roofing materials, refractory insulation and structural insulation, electrical cable, asbestos cloth, "Transite" board, exterior siding/shingles, tape, roll board, brake shoes, or other asbestos containing items.

38 Include actual labor costs for removal of asbestos containing material.

39 Include actual labor costs for encapsulation of asbestos containing material.

40 Include actual labor costs for enclosure of asbestos containing material.

41 Include all premiums directly related to Work of this Contract only.

42 Include actual labor costs for re-insulating, re-wrapping with substitute material and actual material cost.

43 Include actual labor costs for, e.g., HEPA vacuuming, assembly of discarded materials and abated asbestos at Work site and preparation of materials for disposal.

44 Include actual costs of air monitoring and analysis.

45 Include actual costs for hauling and disposal in accordance with applicable Specification Sections.

46 Include actual costs for purchase of capital equipment, e.g., negative air pumps and tools, if directly related to this Contract.

47 Include actual costs for purchase of protective equipment, e.g., "Tyvek" suits, masks, HEPA filters, amended water, and plastic sheeting if directly related to this Contract.

118. PROGRESS SCHEDULE

A. Schedule Requirements

1.) The Contractor shall, at his own expense, prepare, maintain and update detailed electronic progress schedules for the Engineer's review and approval. All submittals required herein shall be in the form and content stipulated in this Section. Each progress schedule shall bear the signature of the Contractor's authorized representative. The progress schedules/graphics required by this Contract shall be produced using the latest version of Oracle – Primavera P6 scheduling software.

2.) The schedule shall be prepared by a scheduler who is an employee of the Contractor with Five (5) years minimum experience in the development and updating of Critical Path Method schedule networks for projects of a complexity comparable to this Contract, or by an outside entity with similar experience specializing in project controls. The Contractor's senior management personnel shall actively participate in the development and updating of the schedule.

3.) Progress schedules shall be sufficiently detailed to accurately depict all the Work and milestones (including acquisition of any required permits, design progress, procurement of subcontractors, all submittals and approvals, materials procurement, including off site fabrication time, and construction activities performed by the Contractor and his subcontractors) and shall graphically represent the logical sequence and duration of activities, all in accordance with the requirements of the Contract. The information provided in progress schedules shall also include, but not be limited to, the interdependencies between the Contractor's Activities and all other Activities required for the successful completion of the Contract, e.g., those to be performed by utility companies or by other entities. All Milestone dates specified in the Contract shall be represented in the schedule by Milestone activities that are logically interrelated to the Work that must be accomplished in order to achieve the Milestone.

4.) All materials furnished by the Authority shall be clearly shown on the baseline schedule. The Contractor shall notify the Engineer each time delivery of material furnished by the Authority has less than thirty (30) calendar days of float.

5.) All activities, except the Contract Start Milestone and Contract Completion Milestone shall be linked to predecessor(s) and successor(s).

6.) The Contractor's schedule shall incorporate the Activity Code Structure shown in Attachment A, and such other coding as may be required by the Engineer.

7.) The Contractor shall load construction activities with budget information and shall identify the cost to perform Work for each construction and management activity. The sum of the costs assigned to all activities shall be equal to the Contract value. No activity costs shall be assigned to the preparation and review of submittals and materials fabrication or procurement.

8.) To assist the Contractor in preparing its progress schedule, a sample Network Diagram is shown in Figure 1. The sample is intended merely as an example of a format for the Contractor's guidance. The types of data shown are the types of data expected to be shown on the Contractor's Network Diagram. However, the information presented in the sample Network Diagram shall not be misinterpreted as either representing a plan for the Contractor's Network Diagram or a depiction of the level of detail which will be required in such diagram.

9.) The submittal of Progress Schedules under this Section shall not be deemed to be a substitute for the reporting requirements of the Section of Division 1 entitled "Daily Progress, Equipment and Labor Reports".

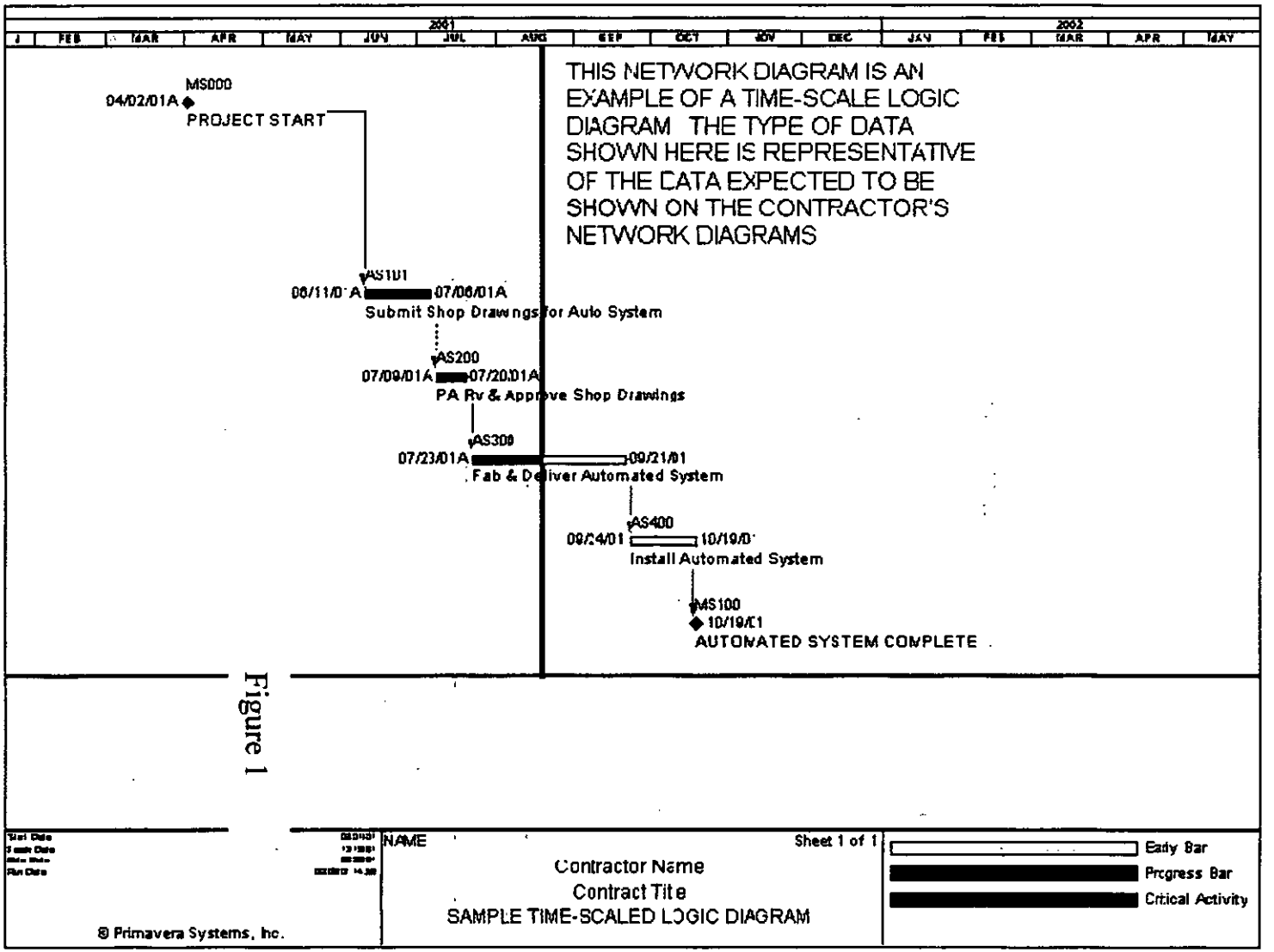
2001
2002
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
THIS NETWORK DIAGRAM IS AN EXAMPLE OF A TIME-SCALE LOGIC DIAGRAM THE TYPE OF DATA SHOWN HERE IS REPRESENTATIVE OF THE DATA EXPECTED TO BE SHOWN ON THE CONTRACTOR'S NETWORK DIAGRAMS
MS000
04/02/01A
PROJECT START
AS101
06/11/01A
07/06/01A
Submit Shop Drawings for Auto System
AS200
07/09/01A
07/20/01A
PA Rv & Approve Shop Drawings
AS300
07/23/01A
09/21/01
Fab & Deliver Automated System
AS400
09/24/01
10/19/01
Install Automated System
MS100
10/19/01
AUTOMATED SYSTEM COMPLETE
NAME
Sheet 1 of 1
Contractor Name
Contract Title
SAMPLE TIME-SCALED LOGIC DIAGRAM
Early Bar
Progress Bar
Critical Activity
© Primavera Systems, Inc.

Figure 1

B. Schedule Terminology

Schedule terminology used in this Contract shall have the meaning described below:

1.) Activity: A discrete item of Work with a Duration that can be clearly defined; a synonym for task. Unless otherwise permitted in writing by the Engineer, an activity's duration shall be not more than 14 calendar days or 10 working days except for non-construction activities, such as procurement cycles, material delivery, soil consolidation, etc. Each activity (task) description shall clearly identify the Work to be performed. No two or more activities in the schedule shall have exactly the same description.

2.) Activity Codes: Activity Codes allow each activity to be grouped into specific classifications such as area, responsibility, phase, system, or location. The codes consist of specific values and descriptive titles that are entered into the data dictionary of the scheduling software. Activities shall be assigned specific Activity Codes as appropriate.

3.) Alternative Solutions: Analyses of various options for dealing with encountered or anticipated Contract problems. Alternative solutions shall be developed to assist in determining the best method(s) of preventing or correcting any impediments to the progress of the Work. Alternative Solutions analysis shall indicate impacts on scheduling and resources.

4.) Analysis Report: A report that displays the impacts of all variances reported in the Current Progress Schedule. The Analysis Report focuses attention on the impacts of variances between planned and actual performance, so as to support an assessment of such impacts. The Analysis Report shall include Alternative Solutions.

5.) Bar Chart: A schedule display designed to complement the Network Diagram. The Bar Chart is a traditional Gantt chart to which the Early Start Dates, Early Finish Dates, Late Start Dates, Late Finish Dates and Critical Path have been added.

6.) Calendar: A calendar defines when Work on an activity can occur (i.e. Mon – Fri for a standard Work week). Activities shall be assigned to a calendar that represents the planned Work days. The calendar shall incorporate the Authority holidays and non-work periods listed in the Hours of Work and Construction Staging. The use of multiple calendars will be permitted.

7.) Constraint: A constraint is a restriction imposed on the start or finish of an activity or the Contract. An example of the use of constraints is the imposition of a "finish no later than" constraint[48] on the Contract Completion Milestone that is equal to the Contract completion date. This constraint facilitates the identification of activities that control or do not support the completion date. Constraints shall be limited to start and finish constraints on milestone activities that represent critical Contract dates, unless otherwise approved by the Engineer in writing.

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48 A late finish or "finish no later than" constraint limits the latest time an activity can complete

8.) Critical Path: The longest path through the network in estimated total elapsed time from the start of the first Activity through the completion of the last Activity. The Critical Path consists of a series of Activities which must be completed on their scheduled completion dates in order for the Contract to be completed on schedule.

9.) Current Progress Schedule: The most recent progress schedule which has been approved by the Engineer. The Original Baseline Schedule shall be referred to as "Revision 0". Each time a different Current Progress Schedule is accepted by the Engineer, the revision number shall be increased by 1 and the old schedule shall be electronically archived so as to permit an audit trail.

10.) Duration: The estimated and/or actual length of time required to fully perform a specific Activity. The Duration for construction activities shall be expressed in Work days.

11.) Early Finish Date: The date upon which an Activity can be completed if it is begun on the Early Start Date.

12.) Early Start Date: The earliest date upon which an Activity can begin.

13.) Hammock: A hammock activity summarizing the early and late dates of a set of activities is used for reporting durations of groups of important activities. An activity shall be designated as a hammock by selecting Hammock as the activity type in the Primavera activity form.

14.) Lag: The interval between the completion of a Predecessor Activity and the start of a Successor Activity. For example, ten days of positive Lag will cause the Successor Activity to begin ten days after the Predecessor Activity has been completed. Negative Lag will cause the Activities to overlap. The amount of Lag between each Activity shall be clearly represented on the Network Diagram.

15.) Late Finish Date: The latest date by which an Activity shall be completed if the succeeding Activity is to be started on schedule.

16.) Late Start Date: The latest date by which an Activity shall be started to allow completion by the Late Finish Date.

17.) Milestone: A significant point in the performance of the Work. A milestone has no Duration, and represents the start of a portion of the Work or the completion of a portion of the Work. A milestone may also represent either the beginning or the completion of a task or action being performed by entities other than the Contractor (e.g., obtaining a permit, notification to proceed with certain Work, etc.).

18.) Negative Float: The amount of time that the planned completion date of an Activity is later than its required (Late Finish) date. An Activity with Negative Float must be completed ahead of schedule if the Work is to be completed on time. Negative Float usually indicates the need for corrective and/or preventive action to complete the Work on schedule.

19.) Network Diagram: A logic diagram prepared according to the Precedence Diagram Method, which displays each Activity required for the performance of the Contract in the sequence in which it is to be performed with appropriate logic ties between activities displayed.

20.) Original Baseline Schedule: The detailed progress schedule first approved by the Engineer as specified herein. All performance of Work will be measured against the Original Baseline Schedule.

21.) Precedence Diagram Method (PDM): A particular type of graphic representation of all Activities and Constraints. The Activities are represented by nodes; the Constraints are represented by lines between nodes. A sample PDM Network Diagram is shown in Figure 1 of this Section.

22.) Predecessor Activity: The partial or full completion of an Activity which is a prerequisite to commencement of another Activity.

23.) Relationship: A logic tie between two activities representing restrictions on the start or completion of the subsequent activity. Relationships may cause either positive or negative lag. The four basic types of relationships are finish to start, start to start, finish to finish and start to finish.

24.) Successor Activity: An Activity which cannot be started or completed without the prior partial or full completion of a Predecessor Activity.

25.) Total Float: The amount of time by which an Activity or series of Activities may be delayed without affecting the date of completion of the Work. Total Float is not for exclusive use or benefit of either the Contractor or the Authority but shall be used for the benefit of the Work in such manner as the Engineer may in his discretion decide. Use of float suppression and manipulation techniques, such as preferential sequencing, lag logic restraints, inflated activity duration and/or constrained dates, other than as may be required by the Contract, shall be cause for rejection of the Original Baseline Schedule and any subsequent schedule revisions and updates.

C. Schedule Submittal, Review & Approval Process

1.) Baseline Schedule

a. Within thirty (30)calendar days of the acceptance of the Contractor's Proposal, the Contractor shall submit a proposed Baseline Schedule containing the Contractor's projected plan and schedule to complete all Work required by the Contract within the time(s) for completion required by the Contract. A schedule showing time(s) for completion later than those required by the Contract will not be accepted.

b. The Engineer will review the Baseline Schedule and return it to the Contractor with comments, or accept it as the Original Baseline Schedule, within fifteen (15) calendar days. The Contractor shall participate in any meetings called to resolve issues with the schedule.

c. If it is not accepted, the Contractor shall revise the Baseline Schedule in accordance with the Engineer's comments and resubmit it for the Engineer's approval within fifteen (15) calendar days of the receipt by the Contractor of the Engineer's comments. Until such time as acceptance of the Baseline Schedule by the Engineer, the Contractor shall continue to resubmit the Baseline Schedule as directed by the Engineer within the same time frame and in the same format as the initial resubmission.

d. After the approval of the Original Baseline Schedule, no changes shall be made therein without the written approval of the Engineer. No other act or omission on the part of the Engineer shall be deemed to constitute such approval. The Contractor shall not be entitled to any damages by reason of the failure of the Engineer to give timely approval or comments on any progress schedule submitted hereunder.

2.) Progress Schedule Updates

a. The Contractor shall submit to the Engineer not less frequently than once a month, on a date specified by the Engineer, an updated Current Progress Schedule. The Engineer may require that the Contractor also include scheduling updates with his monthly payment request. Schedule updates shall status the actual performance and progress of the Work and depict any changes. Schedule updates where early start or early finish of any activity is positioned on the data line but not actualized will not be approved.

b. If directed by the Engineer, within seven (7) calendar days after receipt by the Engineer of an updated progress schedule, the Contractor shall meet with the Engineer for the purpose of reviewing and obtaining the Engineer's approval of it.

c. The Engineer may require the Contractor to furnish a revised update which shall include any other information he may request to assist him in evaluating the Contractor's progress, including but not limited to manpower loading charts and equipment schedules; "what-if" analysis performed in a copy of the current progress schedule, etc.

d. In the event that the Engineer requests the Contractor to revise the updated schedule submitted, and/or to submit such additional information, the Contractor shall make the requested revisions and/or submit the updated schedule to the Engineer for approval along with the additional information requested within seven (7) calendar days of the Engineer's request.

D. Schedule Reporting Requirements

1.) The Original Baseline Schedule submittal shall include the following:

a. One PDF printout file and one Primavera file submitted electronically.

b. Six copies of the following output reports:

(i) A Schedule narrative in writing that provides a general description of the Contractor's approach to meeting the Contract goals and the Critical Path.

(ii) Explanation for any constrained dates.

(iii) A time-scale logic diagram in PDM format containing all activities displaying Activity ID, Activity Description, Calendar, original and remaining durations, percent complete, Early Dates and Total Float, and sorted by:

(a.) Early Start, Total Float

(b.) Total Float, Early Start (Critical Path report)

c. Supporting data showing all activities with their associated cost, budgets or estimates.

d. The Contractor shall electronically archive all accepted schedules.

2.) In addition to the reports required for the Baseline Schedule submittal, all Progress Schedule Update Reports shall include the following:

a. A narrative comparing the current Dates to the respective Milestone Dates, describing the physical progress during the current report period, explaining plans for continuing the Work during the next report period and describing and explaining changes in crewing and construction equipment. The narrative shall also explain changes in Activity durations, logic ties and Activity Values and the reason why the changes were made.

b. Whenever there is any delay or negative float prediction in the schedule, the Contractor shall submit an alternative solutions report that describes the delay, explains when it started and finished or is expected to finish and the basis for those dates and lists the affected schedule activities by activity ID, and he shall present reasons for the delay. Any revisions to durations or the logical sequence of Activities made to reflect these delays shall be explained. The report shall include proposed schedule recovery efforts such as multiple shifts or overtime to mitigate any potential delay to the overall Contract completion date, or request an extension of time, as appropriate.

c. Critical Path Analysis.

d. An Analysis Report indicating Activities and/or Milestones which are behind schedule by at least 30 calendar days (commonly evidenced by Negative Float).

e. A report that compares the Current Progress Schedule update with the Original Baseline Schedule and prior month's accepted schedule update and lists all changes made to the schedule.

E. General Schedule Provisions

1.) Should the Contractor fail to comply with any provision of this Section, The Engineer shall have the right in his discretion to withhold out of any payment (final or otherwise and even though such payment has already been certified as due) such sums as he deems necessary or desirable, all as more fully provided in the clause of the Form of Contract entitled "Withholding of Payments". Furthermore, the Engineer shall withhold the entire initial payment application until the baseline schedule has been approved.

2.) Neither the acceptance, review or approval of any progress schedule or other data submitted by the Contractor pursuant to this Section, nor any other action on the part of the Engineer under this Section shall in any way be deemed to be a representation by the Engineer that the Contractor may or will be permitted to follow a particular schedule or sequence of operations or that by following any such schedule or sequence he may or will complete the Work by the time(s) required by the Contract or by any other time(s). Nor shall the approval of any progress schedule or other such data relieve the Contractor of his obligation to complete the Contract by the time(s) required in the Contract, even though the schedule may be inconsistent with such completion.

3.) Any approval under this Section shall be construed merely to mean that the Engineer knew of no good reason at that time to object thereto. No acceptance, review or approval or any other action under this Section shall limit, affect or impair the Contractor's obligation to perform all Work by time(s) required by the Contract and in accordance with all other provisions of the Contract.

4.) The performance of the Work by the time(s) required in the Contract, after taking into account extensions to which the Contractor may be entitled under the clause of the Form of Contract entitled "Extensions of Time", may require the Contractor to perform the Work using overtime labor, additional shifts or additional plant and equipment and/or other measures at no additional cost to the Authority. The Contractor shall anticipate, avoid and mitigate the effects of all delays.

5.) The Engineer shall have the right at any time when in his judgment the Work is not proceeding in accordance with the approved progress schedule or at any time when it is likely that the Work might not be completed by the time(s) required in the Form of Contract even though the Contractor is proceeding in accordance with the approved progress schedule, to order the Contractor without additional compensation to employ additional shifts to increase the number of men employed, to use additional plant or equipment, or to take such other steps as may be necessary or required to assure the completion within the time(s) shown in the accepted schedule.

6.) No action on the part of the Contractor pursuant to this Section shall be construed as a request by him for an extension of the time(s) for completion required by the Contract. A request for an extension of time shall be deemed made only if it complies with the requirements of the clause of the Form of Contract entitled "Extensions of Time". No extension of the time(s) for completion shall be inferred because of any action, omission to act, or statement on behalf of the Engineer pursuant to this Section. Extension of time, if any, shall be granted only pursuant to the clause of the Form of Contract entitled "Extensions of Time".

7.) The Contractor acknowledges and agrees that he is not entitled to an extension of time for impacts that do not extend the contractual end date of the Contract.

ATTACHMENT A

MANDATORY ACTIVITY CODE STRUCTURE

1.) Responsibility (Authority, Contractor, AE, Subcontractor, Fabricator, Utility, etc.)

2.) Area (Arch Span, NJ Approach, NY Approach, NJ Tower, NY Tower, Ancillary Buildings, Toll Plaza, Maintenance of Traffic, Temporary Structures, Gantries, etc.)

3.) Trade/CSI code (concrete, steel, etc as required)

4.) State (NJ, NY)

5.) Location (NB West Lane, NB East Lane, NB East Shoulder, NB West Shoulder, NB All Lanes, SB West Lane, SB East Lane, SB East Shoulder, SB West Shoulder, SB All Lanes, etc.)

6.) Phase of Work (Submittal, Review, Procurement, Fabrication, Construction, Punch-list, Closeout, etc.)

7.) Stage (0, 1, 2, 3, 4, 5)

8.) Closure (Night, Weekend, Day, None, etc.)

9.) Change Order work, Net Cost Work, if applicable

10.) Other, as required by the Engineer

PRIMAVERA PROJECT PLANNER

Date 01/02/0 -----ACTIVITY CODES DICTIONARY----- Page 1

NAME - Project Title

CODE	VALUE	TITLE	SEQUENCE
Activity Codes:			
RESP	Responsibility		
	AE	Architect/Engineer	
	C	Contractor	
	O	Port Authority	
AREA	Area		
	G	General Area	1
	CTL	Air Traffic Control Tower	2
MILE	Milestone		
CSI	Trade/CSI Code		
	03000	Concrete	
	04000	Masonry	
	07000	Thermal & Moisture Protection	
	15000	Mechanical	
	16000	Electrical	
LOCN	Location		
PHAS	Phase		
	D	Design	1
	P	Procurement	2
	C	Construction	3
CO	Change Order Wor		
OTH	As Req'd by Engr		

119. ANALYSIS OF BID

Within fifteen calendar days after acceptance of the Proposal, the Contractor shall prepare a detailed analysis of bid on forms furnished by the Authority with all of the spaces filled in without exception, and containing such information as the Engineer may require for each of the items enumerated in such form.

120. CONDITIONS AND PRECAUTIONS

A. Construction Site Conditions:

1.) Notwithstanding restrictions specified elsewhere herein, during the time the Contractor is performing the Work, it may at times be necessary, because of emergency conditions, to suspend the Contractor's operations or to postpone the time at which a work area becomes available for performance of Work. Should the Contractor be specifically directed to suspend operations in a work area specified herein to be available for operations of the Contractor, or should such work area not be available by the times specified elsewhere in the Contract, and if solely because of such suspension of operations or late availability of the work area, the Contractor is necessarily kept idle at the construction site, the Contractor will be compensated as stipulated in the provisions of the Contract concerning compensation for emergency delays.

2.) At least 7 days but not more than 10 days prior to performing excavation, call 1-800-272-4480 and provide the information required for excavation(s) in New York and call 1-800-272-1000 and provide the information required for excavation(s) in New Jersey.

3.) No vehicles of the Contractor, employees of the Contractor, subcontractors, materialmen or others over whom the Contractor has control will be permitted to park in or on Authority property, except for construction vehicles which will be permitted to park at the area of Work during the times when the Work is being performed and as designated by the Engineer. The Contractor shall provide a designated parking area for workers vehicles and shall limit the amount of parking on city streets within the vicinity of the work area.

4.) All vehicles, including construction vehicles and company vehicles will be required to pay the appropriate tolls for each passage or crossing of Authority facilities, or parking at Authority lots.

5.) Securely fasten material or construction which must be left in place between working periods in a manner approved by the Engineer so as not to be a hazard.

6.) Take all precautions necessary for protection of persons, traffic and property during dust or fragment generating operations, concrete mixing or placing, or other operations which may stain, soil or damage property or injure persons. Provide and erect waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less, or other protective enclosures as approved by the Engineer.

7.) Restrict smoking to areas designated by the Engineer for this purpose.

8.) Do not burn or bury debris of any type on Authority property, or wash waste materials down sewers or into waterways.

9.) Provide sound suppression devices on gasoline and diesel powered construction equipment and pneumatic tools as required to maintain noise exposures below the limits specified in the Code of Federal Regulations (CFR) 29 CFR 1926 Occupational Safety and Health Regulations for Construction (OSHA). Maintain such sound suppression devices in proper operating condition throughout the time of their use, and adjust and repair as required to maintain noise within exposure levels stipulated in 29 CFR 1926.52, Table D-2.

10.) During the course of theWork, the Contractor shall remain clear of V36 historic underwater shipwreck. The New Jersey State Plain coordinates (feet) of the center of the V36 shipwreck are X: 593,084.1052 ft; Y: 660,027.4598 ft . The Contractor shall remain at least 270' from this point at all times.

11.) Throughout the Contractor's Work, roadway surfaces of the streets below the elevated work area, shall be kept clean, free of obstructions, and suitable for the safe unimpeded movement of traffic.

12.) No plates shall be left within the travel lanes from November 1st through April 1st.

13.) On or about October 15th of each year, the Engineer will hold a winter work coordination meeting with the Contractor and Facility Operations. During winter weather events, the Facility will perform roadway clearing for travel lanes used by the public, and this work shall take priority over Contractor operations.

14.) Salt storage shed shall remain accessable during the period from November 1st through April 1st.

15.) Truck travel to support the Contractor's activities shall be kept off local streets in the area around the construciton site between the hours of 6AM and 9AM and between the hours of 4PM and 7PM, Monday through Friday.

16.) The Contractor shall comply with requirements set forth in Title 14 of the Code of Federal Regulations (CFR), Part 77 for all Work affecting Navigable Airspace.

B. No requirement of or omission to require any precautions under this Contract shall be deemed to limit or impair any responsibility or obligation assumed by the Contractor under or in connection with this Contract and the Contractor shall at all times maintain adequate protection to safeguard the public and all persons engaged in the Work and shall take such precautions as will accomplish such end, without undue interference with the public or the operations of the Authority.

121. HOURS OF WORK AND CONSTRUCTION STAGING

A. Hours of Work

1.) Subject to all requirements stated elsewhere herein, the Work shall be performed in accordance with the following restricted hours of Work.

a. Perform Work at the Bayonne Bridge as follows:

(i) If no lane closure is required, Monday through Sunday, at any time of day or night.

(ii) Prior to the start of construction stage 1, between the hours of 6:00 AM and 4:00 PM, Monday through Saturday, if single lane closures are required. The Contractor will not be permitted to commence lane closures between 6:15AM and 9AM. Only one lane of traffic shall be closed at any given time, leaving three total lanes open at all times.

(iii) Between the hours of 9:00 PM and 5:00 AM the next morning (if a full overnight closure is required starting Sunday through Thursday evenings), or between 11:59 PM and 8:00 AM the next morning (if a full overnight closure is required starting Friday or Saturday evenings). The Contractor may commence closure operations fifteen minutes before the stated time. No full overnight closures will be permitted until January 1, 2014.

(iv) Between the hours of 9:00 PM Friday and 5:00 AM Monday if a full weekend closure is required.

(a.) A maximum of 8 full weekend closures will be permitted per calendar year. No full weekend closures will be permitted during the months of June, July and August. No full weekend closures will be permitted until January 1, 2014.

2.) Notwithstanding anything to the contrary hereinabove, for the duration of the Contract, no closure of any traffic lanes is permitted during the following periods:

a. Memorial Day weekend (5:00 AM Friday through 5:00 AM Tuesday).

b. President's Day weekend (5:00 AM Friday through 5:00 AM Tuesday)

c. Independence Day weekend (5:00 AM Friday through 5:00 AM Tuesday if the holiday falls on a Monday; 5:00 AM Thursday through 5:00 AM Monday if the holiday falls on a Friday; and 5:00 AM the day before to 5:00 AM the day after if the holiday falls in the middle of the week).

d. Labor Day weekend (5:00 AM Friday through 5:00 AM Tuesday).

e. Mother's Day and Father's Day weekends (8:00 AM Saturday through 5:00 AM Monday).

f. Thanksgiving weekend (5:00 AM Wednesday before the Holiday through 5:00 AM Monday).

g. Christmas through New Year (5:00 AM December 23 through 5:00 AM January 2)

h. Easter weekend (5:00 AM Friday through 5:00 AM Monday).

i. From 5:00 AM the day before to 5:00 AM the day after the start of Rosh Hashanah, Yom Kippur, Passover and Hanukkah.

j. The 2014 Super Bowl (8:00 AM Saturday, February 1, 2014 through 5:00 AM Monday, February 3, 2014)

k. The 2013 MLB All-Star Game (8:00 AM Monday, July 15, 2013 through 5:00 AM Wednesday, July 17, 2013)

l. New York City Marathon weekend (8:00 AM Saturday through 5:00 AM Monday the weekend of the Marathon in November)

3.) The Contractor shall submit to the Engineer, at least one week in advance, his scheduled hours of Work for each week. The Contractor shall provide the Engineer four weeks' notice for full weekend closures.

4.) Do not perform Work at the construction site outside of these time periods or on a Federal legal holiday or a holiday of the State(s) in which the Work is being performed, unless otherwise permitted by the Engineer.

5.) Prior to the end of each work period, Contractor shall remove all lane closures and return all roadways to roadway traffic.

B. Construction Staging

1.) Construction staging is shown on Contract Drawings CS0101-CS0112. The Contractor shall submit any deviations from the suggested sequence to the Engineer for review and approval.

2.) Hoisting of precast pier sections or precast box girder segments to any point higher than the adjacent roadway elevation shall be performed only during a full bridge closure.

3.) Steel Framing and concrete placement for the new arch roadway shall be performed only during a full bridge closure.

4.) Load transfer of suspender ropes, shall be performed only during a full bridge closure.

122. MAINTENANCE OF TRAFFIC AND WORK AREA PROTECTION

A. Definitions

As used in this numbered Section, and this Section only, the terms used herein shall have the following meaning:

1.) The terms "Traffic Lane", "Lane", "Active Roadway", "Street", and "Roadway" shall mean, in addition to the normally traveled pavement areas, other areas including but not limited to ramp terminal gore areas, roadway shoulders and all other areas that may foreseeably be occupied by moving vehicles.

2.) "Flashing Arrow Sign Unit" (FASU) shall mean an engine/generator-, solar- or battery-powered flashing light sign with lights displayed in the shape of an arrow.

3.) "Variable Message Sign Unit" (VMSU) shall mean an engine/generator-, solar- or battery-powered variable text sign using a matrix composed of elements such as fluorescent flip-disc, fiber optic, light-emitting diode (LED) or incandescent bulb elements.

4.) "Nighttime " shall mean the local time period between 1/2 hour after sunset to 1/2 hour before sunrise.

5.) "Slow-Moving Vehicles" shall mean vehicles or equipment that travel at or under a speed corresponding to 15 mph less than the posted speed limit.

6.) "Work Area" shall mean the area immediately surrounding the Work in progress, typically where workers are afoot, and/or the space within a Roadway where Work on the Roadway is being done by the Contractor.

B. General Requirements

Conform to requirements of this numbered Section, the Contract Drawings and the following:

1.) Portions of the latest editions, including all amendments thereto, of the Federal Highway Administration (FHWA): "Manual on Uniform Traffic Control Devices" (MUTCD) Part VI as hereinafter specified and applicable portions of the companion "Traffic Control Devices Handbook" (TCDH); "Standard Highway Signs"; "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects"; and the "Standard Color Tolerance Charts".

2.) American Association of State Highway and Transportation Officials (AASHTO): "Roadside Design Guide", Chapter 9: Safety Appurtenances for Work Zones; and "Standard Specifications for Highway Bridges", as hereinafter specified.

3.) The requirements of the Americans with Disabilities Act (ADA) laws in all respects as specified in the "ADA Accessibility Guidelines for Buildings and Facilities" (ADAAG).

4.) American Traffic Safety Service Associations (ATSSA): "Guidelines for the Use of Portable Changeable Message Signs".

5.) Maintenance of traffic and Work Area protection features specified herein and as shown on Contract Drawings and/or sketches to be furnished to the Contractor.

6.) In the event of a technical conflict between a requirement in the publications referenced herein and the Specifications and Contract Drawings, the requirements of the Specifications and Contract Drawings shall control.

7.) There may be more than one Work Area within the confines of a closed Roadway or Traffic Lane. Each Work Area shall be individually protected as specified herein.

C. Contractor-Furnished Materials and Equipment

1.) Provide and maintain in good working order all materials, equipment, temporary construction signs and facilities required for proper maintenance of traffic and Work Area protection, as specified herein and/or shown on the Contract Drawings. All said equipment/devices shall remain the property of the Contractor, unless otherwise shown on the Contract Drawings.

2.) All items provided under paragraph C.1 shall be new or undamaged previously used materials in serviceable condition conforming to requirements specified herein.

3.) Provide and maintain in serviceable condition the following, as shown on the Contract Drawings:

a. Portable Changeable Message Signs: Trailer mounted FASU or VMSU.

b. Traffic Cones.

c. Traffic Guide Posts.

d. Plastic Delineator Drums.

e. Type III Barricades.

f. Vehicle-strong Barriers.

(i) Precast Concrete Barrier

(a.) Type 1.

(b.) Type 4.

(ii) Water-filled Barrier Sections: As manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

g. Temporary Signs: Conform to requirements of Specification Section 02850 "Plywood Sign Panels and Wood Sign Posts" and/or Specification Section 02851 "Aluminum Sign Panels" hereof. Plywood signs shall be Type 1, unless otherwise shown on the Contract Drawings.

(i) Temporary Sign Supports: Wood conforming to requirements of Specification Section 02850.

(ii) Portable Sign Supports: "Windmaster" as manufactured by Marketing Displays, Inc., Farmington Hills, MI.; or approved equal;

h. Portable Impact Attenuator, Structural Type: "G-R-E-A-T System" as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

i. Portable Impact Attenuator, Inertial Sand Barrel Type: "Energite System" as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

j. Temporary Timber Curbs and Concrete Barriers: Conform to the Contract Drawings and Specification Section 02842 "Temporary Traffic Barriers";

k. Warning Lights: Units as listed below conforming to the requirements of Part VI of the MUTCD as certified product catalog cuts and/or by independent testing laboratory reports, copies of which, upon request, shall be submitted to the Engineer for approval.

(i) Nighttime: Type A Low Intensity Flashing Warning lights using 12-volt circuit and lamp units with vandal resistant off/on switch and mounting hardware, photocell, and new bulbs and batteries.

(ii) Daylight and Nighttime: Type B High Intensity Flashing Warning lights with vandal resistant off/on switch and mounting hardware, and new bulbs and batteries. Type B Flashing Light battery cases shall be set on the ground/pavement and equipped with a neatly routed electrical cord to the detachable, remote mounted light head.

(iii) Nighttime: Type C Low Intensity Steady-Burn lights with vandal resistant off/on switch and mounting hardware, photocell, and new bulbs and batteries.

l. Back-Up Trucks: Nominal actual weight of 15,000 lbs. with nominal 24,000 lbs. gross vehicle weight registration and rear-most wheels situated close to rear of truck body. Standard "ICC" type rear bumpers are not an acceptable substitute for the required rear wheel location. Actual vehicle weight may vary depending on recommendations of the manufacturer of the vehicle-mounted impact attenuator selected. In addition, equip truck(s) with:

(i) Standard 4-lamp flashing hazard signal lights (parking and tail lights);

(ii) Four-lamp sealed beam rotating yellow warning light providing 35,000 candle power per lamp with an apparent flash rate of 120 flashes per minute. Truck mount such lights 7 to 10 feet above the Roadway and located so as to be visually unobstructed by any part of truck body, load or equipment.

(iii) Vehicle-Mounted Impact Attenuator: "TMA" units as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

m. Temporary Roadway Plates: Steel Plates, sized to cover Roadway excavations with thickness and edge support adequate to accommodate HS-20-44 loading per Figure 3.7.6B and 3.7.7A in the AASHTO "Standard Specifications for Highway Bridges".

n. Temporary Reflectorized Pavement Marking

(i) On Finished Wearing Surfaces: New, unused removable temporary marking tape conforming to the requirements of Specifications Section 02582 "Preformed Removable Retro-Reflective Pavement Marking Tape" shall be furnished, applied and maintained. For removal see paragraph E.3.d.

(ii) On Roadway Surfaces to be Subsequently Resurfaced or Replaced Under This Contract: An approved traffic paint with glass beads applied at the rate of 1.5 pounds per 100 linear feet per 4-inch wide line, unless otherwise shown on the Contract Drawings. For removal see paragraph E.3.d.

o. When required by paragraph E.6 or utilized by the Contractor in paragraph E.7 herein, provide bituminous premixed asphalt concrete cold patch material.

4.) Submit the following to the Engineer in accordance with Division 1 - GENERAL PROVISIONS entitled "Shop Drawings, Catalog Cuts and Samples":

a. Catalog Cuts and Data Sheets: Complete manufacturer's data for all equipment and materials.

D. Spare Materials and Equipment

1.) Initially furnish and subsequently maintain the quantities of spare materials and equipment, as scheduled on the Contract Drawings, at the construction site or at another nearby location approved by the Engineer.

2.) In addition to the required number of spare flashing and steady-burn lights, maintain an adequate quantity of appropriate spare batteries and light bulbs at the construction site. Replace batteries and light bulbs in the in-use warning lights as follows:

a. For Nighttime Type A Low Intensity Flashing Warning lights, after 30 consecutive days of operation, or sooner as needed.

b. For Type B High Intensity Flashing Warning lights, after 30 consecutive days of operation, or sooner as needed.

c. For Nighttime Type C Low Intensity Steady-burn lights after 15 consecutive nights of operation, or sooner if needed.

3.) Totally relamp Flashing Arrow Sign Unit after each single bulb failure.

E. General Work Area Protection

1.) Contractor shall establish a Traffic Maintenance Crew, properly trained, supplied, staffed and equipped to deploy and remove the maintenance of traffic and Work Area protection elements required for each of the Contractor's construction activities, as described on the Contract Drawings and/or paragraph E.3 herein. The Contractor shall identify and maintain one individual, per work period, as the central or key contact for the Traffic Maintenance Crew and their associated activities.

2.) Contractor's Traffic Maintenance training shall be specifically developed from this Section. The contents of Contractor's Training programs shall specifically include the Contract Drawings Traffic Standard Details and all other requirements included on the Contract Drawings.

3.) Prior to commencement of each day's Work, furnish and install, and periodically inspect, maintain, relocate, replace, cover, remove or reconstruct the traffic control delineations, guiding devices, signals, signs and pedestrian protection, Roadway plates, barricades, and barriers, if any, as required throughout the progress of construction operations. Maintain safe control of traffic flow and demarcate areas of Work at all times.

a. Ensure that construction material and equipment not removed from areas of Work during non-working periods are protected in such a manner that they shall not constitute a traffic hazard.

b. Do not park any vehicles other than construction vehicles required for construction operations within the demarcated protected areas of Work.

c. Promptly remove traffic control delineations, guiding devices, signals, signs, pedestrian protection, Roadway plates, barricades and barriers and whenever operations under this Contract no longer require said Work Area protection.

d. All existing permanent and temporary pavement markings and traffic guides that conflict with markings and traffic guides to be installed shall be concurrently removed prior to placement of new pavement markings and traffic guides as follows:

(i) On wearing surfaces that will be subsequently replaced, resurfaced or abandoned during the Work of this Contract, remove obsolete temporary marking tape and remove or obliterate obsolete thermoplastic or paint markings in a manner approved by the Engineer so as to completely obscure all obsolete markings for the duration of the Work.

(ii) On finished wearing surfaces, completely remove temporary marking tape and completely remove obsolete permanent markings in a manner approved by the Engineer. Use of blackout paint or other coating material on any finished wearing surface is prohibited.

(iii) Grind or chip off all adhesive residue resulting from removed or relocated traffic guides.

e. Prior to the end of each work period and not less than twice a day on non-work days, the Contractor's Traffic Maintenance crew shall visually inspect and maintain all elements of the maintenance of traffic and Work Area protection installations.

4.) Throughout Progress of Work of This Numbered Section

a. Maintain visual and physical accessibility to fire hydrants. Provide 24-hour advance notice to the Engineer in the event of hydrant obstruction.

b. Conduct Work Area protection operations so that Traffic Lane ingress and egress to intersecting Roadways, adjacent structures or property, and bus and taxi stops, if any, can be maintained. Obtain the approval of the Engineer and provide 24-hour advance notice to the Engineer in the event that Work Area protection operations obstruct access to Work Areas.

5.) Placement and Removal of Temporary Signs and Traffic Control Devices

a. Do not locate signs or other traffic delineations, guiding devices and signs in a manner that would: obstruct or interfere with motorists view of approaching, merging or intersecting traffic; obstruct other permanent signs or route markers; or mislead or misdirect the motorist.

b. Do not place traffic control signs under an overpass or elevated building, or within overpass or building shadow areas, unless otherwise shown on the Contract Drawings.

c. On Roadways passing below an overpass or elevated building, do not begin or end traffic cone or other delineation and guiding devices under or less than 100 feet from an overpass or building. Extend delineation and guiding devices as required to comply with this requirement.

d. Unless otherwise shown on the Contract Drawings, the Work of installing and removing temporary signs, traffic control devices and pavement marking shall be protected, as a minimum, in accordance with Contract Drawing Standard Traffic Details and/or the MUTCD Part 6, as applicable.

6.) At excavations within Traffic Lanes which will be open to Roadway traffic prior to completion of construction, provide and maintain temporary Roadway plates supported on all edges, and maintain the surface condition of the Active Roadway and Roadway plates so that it is consistent with the posted speed limit. Secure plates against displacement by use of suitable steel pins.

a. Secure plate against displacement and bed in well-tamped pre-mixed cold patch material ramped 1:24 at exposed edges, or

b. Cut a recess in the Roadway surface sized to snugly fit the plate and evenly support the plate around its perimeter. Locate the top of the plate flush with or less than one inch below the adjacent Roadway surface. Secure the plate in the recess in a manner approved by the Engineer.

7.) At excavations within pedestrian walkways including Traffic Lane crosswalks which will be open to walkway pedestrian traffic prior to completion of construction, provide appropriate pedestrian railings and steel plate, wood plank or plywood covers surfaced with an approved heavy duty non-skid paint coating containing a grit additive. Temporary walkway covers over excavations shall be a minimum of 4-feet wide, designed and constructed to carry a minimum of 150 psf. Railings shall be approximately 3 feet 6 inches above the walkway cover and consist of a 2-inch by 4-inch wood top rail, 1-inch by 4-inch intermediate rail and a toe board 5-1/2 inches high all securely fastened to 2-inch by 4-inch wood posts spaced not more than 8 feet apart. Securely fasten wood walkway covers and posts to wood sleepers spanning excavation trench. Chamfer or asphalt ramp exposed edges and secure against displacement. Contractor's installations shall meet the requirements of the ADA laws in all respects.

8.) Use temporary Vehicle-strong Barriers at all times when the Work Area contains open excavations or when materials and/or equipment are left in the Work Area without the presence of workers, unless otherwise shown on the Contract Drawings. Flare exposed ends of the barriers away from the Active Roadway by extending the barriers beyond the roadside recovery area and terminate the barriers with a tapered end section. Where proper flaring of the barriers cannot be obtained, protect the barrier end with Inertial Sand-Filled Barriers or Portable Impact Attenuators. Where Inertial Sand-Filled Barriers or Portable Impact Attenuators are used, do not install tapered barrier end section.

9.) Each Work Area not protected by Vehicle-strong Barriers shall be protected by a back-up truck when workers are present, unless otherwise shown on the Contract Drawings.

10.) Vehicles used by the Contractor during performance of Work shall be considered as equipment vehicles and when not protected by a Vehicle-strong Barrier, said vehicle shall be protected by a back-up truck, unless otherwise shown on the Contract Drawings.

11.) Slow-Moving Vehicles traveling on a Roadway outside of demarcated protected Work Areas shall be followed (approximately 50 feet behind) by a vehicle displaying the same flashing hazard signal lights and sealed beam rotating yellow warning light as required for back-up trucks.

F. Notwithstanding provisions herein requiring or permitting the Authority to approve or disapprove of any traffic control or delineation and guiding device provided by the Contractor, the Contractor shall ensure the suitability and performance of all such traffic control devices such that inconvenience to the traveling public is held to an absolute minimum.

123. SUSTAINABILITY REQUIREMENTS

General Requirements

Conform to the requirements of this numbered Clause, the Contract Drawings, Division 1 and Division 2 through 16 Sections for the following sustainability elements:

1.) Materials with recycled-content.

2.) Locally manufactured materials.

3.) Forest Stewardship Council (FSC)-Certified wood materials.

4.) Rapidly renewable (agricultural) materials.

5.) Low-emitting materials.

6.) Site Environmental Plan.

7.) Indoor Air Quality Management Plan.

B. LEED Accredited Professional

The Contractor shall designate a LEED Accredited Professional for the preparation and submittal of all sustainability submittals to the Engineer and for the coordination of all sustainability requirements as specified herein.

C. Sustainability Submittals

For all materials requiring Sustainability Submittals, assemble into one package per Section or Division and submit the following information to the Engineer:

1.) The Sustainable Materials Certification Form (SMCF) on the form bound herewith, with all spaces filled in as applicable. Such form shall include costs associated with the Work computed in accordance with the stipulations of the clauses contained in Chapter II of the Form of Contract.

2.) Documentation to validate the information provided on the SMCF. Where published product literature is submitted, clearly encircle or flag the relevant sustainability information. Such documentation shall be as follows:

a. Recycled Content: Submit published product literature or letter of certification on the manufacturer's letterhead certifying the amounts of post-consumer and/or post-industrial content.

b. Regional Manufacturing (within 500 miles of the construction site): Submit published product literature or letter of certification on the manufacturer's letterhead indicating the city/state where the manufacturing plant is located and the distance in miles from the construction site.

c. Regional Raw Materials (within 500 miles of the construction site)

(i) Submit published product literature or letter of certification on the manufacturer's letterhead indicating the city/state from which each of the raw materials in the product were extracted, harvested or recovered, and the distance in miles from the construction site.

(ii) If only portions of the raw materials for a particular product or assembly originate within 500 miles of the construction site, submit the percentages (by weight) of these materials incorporated in the complete product or assembly.

d. Certified Wood

(i) Submit vendor invoices for each wood product that has been harvested in accordance with the "FSC Principles and Criteria" for well-managed forests developed by the Forest Stewardship Council (FSC). Invoices shall include chain-of-custody (COC) certificate numbers and itemized costs for all certified products.

(ii) For assemblies, submit the percentage (by cost and by weight) of the assembly that is FSC-certified wood.

e. VOC Content: Submit Material Safety Data Sheets (MSDS) certifying the Volatile Organic Compound (VOC) content of adhesive, sealant, paint, and coating products. VOC content shall be reported in grams/liter or lbs./gallon. If the MSDS does not show the product's VOC content, submit this information through other published product literature from the manufacturer, or stated in a letter of certification from the product manufacturer on the manufacturer's letterhead.

f. Rapidly Renewable (Agricultural) Materials: For all products made from raw materials harvested within a ten-year cycle or less, submit vendor invoices, Letters of Certification (where applicable) and product literature detailing specifics of rapidly renewable (agricultural) materials.

3.) Other Product Documentation

a. Product Cut Sheets: Submit product cut sheets with written confirmation that the submitted products are the products that were furnished and installed for the Contract.

b. Carpet and Rug Institute (CRI) Green Label Certification: For carpets, carpet tiles and carpet cushions, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products comply with the "Green Label" IAQ testing program of the Carpet and Rug Institute of Dalton, GA.

c. Carpet Component Identification: For all synthetic carpets, submit documentation from the manufacturer (on the manufacturer's letterhead) of the specific carpet component identification code that is printed on or attached to the carpet supplied for the Contract. The code shall identify the carpet face fiber and its primary backing, secondary backing, adhesive, adhesive filler, and dyes if applicable.

d. Certification of Composite Wood or Agrifiber Resins: For all composite wood, engineered wood and agrifiber products, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that that the products do not contain added urea-formaldehyde or phenol-formaldehyde resins.

e. Certification of Composite Wood or Agrifiber Laminating Adhesives: For all laminating adhesives used with composite wood, engineered wood and agrifiber products (e.g., adhesives used to laminate wood veneers to an engineered wood substrate), submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that that the adhesive products do not contain urea-formaldehyde.

f. Green Seal Compliance: Submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the following product types comply with the VOC limits and chemical component restrictions developed by the Green Seal organization:

(i) Topcoat Paints: Refer to Green Seal Standard GS-11 (1st edition, May 1993).

(ii) Anti-corrosive and Anti-rust Paints: Refer to Green Seal Standard GC-03 (2nd Edition, January 1997).

(iii) Aerosol Adhesives: Refer to Green Seal Standard GS-36 (1st Edition, October 2000).

g. Energy Star Label Certification: For office equipment and electronics, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products are rated under the US EPA/DOE Energy Star program.

h. Low Mercury Fluorescent Lamps: For all fluorescent lamps installed as Work of this Contract, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the lamps contain less than 10 milligrams of mercury, and can be disposed of as non-hazardous waste, as defined by the US EPA.

i. GreenGuard Certification: For systems furniture and seating, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products are certified by the GreenGuard Environmental Institute.

4.) Tabulate all values (e.g., distance from construction site for resource harvest, cost of rapidly renewable materials, VOC content of products, etc.) from approved SMCFs and submittals per Division once every month and submit to the Engineer for progress review.

D. Recycled Content

1.) In the performance of the Work of this Contract, use building materials with recycled content such that post-consumer recycled content plus one-half of post-industrial recycled content constitutes a minimum of 10 percent of the cost of materials (specified in Divisions 2 through 10) used for the Contract. Calculate the Percent Recycled Content and Recycled Content Value in accordance with the following:

a. Percent Recycled Content (%) = Total Recycled Content Value / Total material cost.

b. Recycled Content Value ($) = (% post-consumer recycled content x material cost) + 0.5 x (% post-industrial recycled content x material cost).

c. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims", 16 CFR 260.7 (e), Washington: USFTC, 1992.

d. Report the Percent Recycled Content on the SMCF and submit to the Engineer on a monthly basis.

E. Material Proximity

1.) In the performance of the Work of this Contract, use a minimum of 50 percent (by cost) of all building materials (specified in Divisions 2 through 10) that are regionally manufactured or harvested within 500 miles from the construction site. Calculate the Percent Local Materials in accordance with the following:

a. Percent Local Materials = Total Cost of Local Materials ($) / Total Materials Cost ($).

b. Report the Percent Local Materials on the SMCF and submit to the Engineer on a monthly basis.

F. FSC-Certified Wood Materials

1.) In the performance of the Work of this Contract, use a minimum of 50 percent of all wood building materials (by cost, and whether permanently-installed or temporary) that are harvested in accordance with the "FSC Principles and Criteria" for well-managed forests developed by the Forest Stewardship Council (FSC). Calculate the Percent of FSC-Certified Wood in accordance with the following:

a. Percent of FSC-Certified Wood = FSC-Certified Wood Material Value ($) / Total New Wood Material Value ($).

b. Report the Percent FSC-Certified Wood on the SMCF and submit to the Engineer on a monthly basis.

G. Rapidly Renewable (Agricultural) Materials

1.) In the performance of the Work of this Contract, use 5% of all building materials (by cost) that are "Rapidly Renewable Materials" made from plants typically harvested within a ten-year cycle or less. Calculate the Percent of Rapidly Renewable Materials in accordance with the following:

a. Percent of Rapidly Renewable Materials = Total Cost of Rapidly Renewable Materials ($) / Total Materials Cost ($).

b. Report the Percent of Rapidly Renewable Materials on the SMCF and submit to the Engineer on a monthly basis.

H. Site Environmental Plan

1.) Implement and submit to the Engineer a Site Environmental Plan with measures to reduce the impact of pollution, noise and vibration from construction activities and vehicles on adjoining areas. Such Plan shall address the following:

a. Location of areas for materials delivery and construction access routes to create minimum disruption to the facility and surrounds.

b. Compliance with the Division 1 clause entitled "Diesel-Powered Equipment" for diesel fuel requirements.

c. Consideration of bio-diesel fuel as an alternative to pure diesel fuel.

d. Location of fixed diesel powered exhausts away from fresh air intakes.

e. Reduction of noise and vibration impacts through scheduling and coordination with adjacent construction activities. Utilization of noise barriers where practicable.

f. Coordination of construction activities in adjacent and nearby locations to avoid or minimize impacts on surrounding buildings, structures, infrastructure and utilities where appropriate.

I. Indoor Air Quality Management Plan

1.) General

a. Implement and submit to the Engineer an Indoor Air Quality (IAQ) Management Plan in accordance with NYS Executive Order 111, Article 19.638.7(d)(1).

b. Conduct indoor air quality testing in accordance with NYS Executive Order 111, Article 19.638.7(d)(1) and submit test results to the Engineer.

c. Designate one LEED Accredited individual from the Contractor's staff to be the IAQ representative. Such representative shall report IAQ Management Plan progress to the Engineer on a regular basis and assemble required IAQ submittals.

2.) Definitions

a. Type 1 Materials: Materials and finishes that act as sources of VOC or particulate contamination. Type 1 materials can include "wet" products, such as paints, sealants, adhesives, sealers and fireproofing materials as well as "dry" products such as flooring coverings with plasticizers, and engineered wood with formaldehyde.

b. Type 2 Materials: Materials and finishes which are woven, fibrous, or porous in nature and which tend to absorb chemicals or particulates released by Type 1 materials. Examples include textiles, carpeting, acoustical ceiling tiles and gypsum board. Type 2 materials can become "sinks" for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth.

3.) References

a. "IAQ Guidelines for Occupied Buildings under Construction", First Edition, November 1995: Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), www.smacna.org.

b. ANSI/ASHRAE 52.2-1999, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", www.ashrae.org.

4.) The IAQ Management Plan shall meet the following minimum requirements:

a. Plan and perform construction activities to meet or exceed the standards included in Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) "IAQ Guidelines for Occupied Buildings under Construction," First Edition, 1995. The five major categories of IAQ measures from Chapter 3 are listed below. Organize the IAQ Management Plan in accordance with the SMACNA format, and address measures to be implemented by the Contractor and/or subcontractors in each of the five categories (including subsections). Items not applicable to this Contract should be indicated as such.

HVAC Protection: • Return Side • Central Filtration • Supply Side • Duct Cleaning
Source Control: Product Substitution: • Modifying Equipment Operation • Changing Work Practices • Local Exhaust • Air Cleaning • Cover or Seal
Pathway Interruption: • Depressurize the Work Area • Pressurize Occupied Space • Erect Barriers to Contain Construction Areas • Relocate Pollutant Sources • Temporarily Seal the Building
Housekeeping: • Routine Jobsite Cleaning • Protection of Stored Materials • Protection of Materials During and After Installation
Scheduling: • Airing-out of New Materials • Sequencing of Finish Applications • Proper Curing of Concrete before Covering • Installation during Unoccupied Periods

b. Protection of Materials from Moisture Damage: Under the Housekeeping category of the IAQ Management Plan, describe measures to protect stored or installed absorptive materials (Type 2) from moisture damage. Also describe measures to be taken if moisture damage does occur to absorptive materials during the performance of the Work.

c. Installation and Replacement of Filtration Media: Under the HVAC Protection category of the IAQ Management Plan, describe the filtration media in ventilation equipment, including replacement criteria for filtration media during construction and confirmation of filtration media replacement for equipment, immediately prior to completion of Work. Filtration media shall meet the requirements of 5.) below.

d. Sequence of Finish Applications for Materials: Furnish and install absorptive materials (referred to herein as "Type 2 Materials") after the installation of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds (referred to herein as "Type 1 Materials"). Absorptive materials include, but are not limited to: carpets; acoustical ceiling panels; fabric wall coverings; insulation (exposed to the air stream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, wood preservatives and finishes; control and expansion joint fillers; hard finishes requiring adhesive installation; gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders.

e. Ventilation during installation of materials and finishes: Supply 100 percent outside air during the installation of materials and finishes, beginning after the building or applicable portion of Work is substantially enclosed. If building HVAC systems are used to supply the ventilation air, furnish and install filtration media in accordance with 5.) below.

f. Flush-out /Air Purging: Conduct flush-out on every floor (or applicable portion of Work) immediately prior to completion of all Work, based on the following parameters:

(i) Air-flow rate: Supply minimum air-flow for the duration of the flush-out period as follows:

(a.) When outside air temperatures are between 55 and 85 degrees F, and the relative humidity between 30 and 60 percent, supply 100 percent outside air at a minimum of 50 percent of the full airflow rate of the fan during typical operating conditions.

(b.) When outside air temperatures and relative humidity are outside the ranges specified in the paragraph directly above, supply 100 percent outside air at a minimum of 25 percent of the full airflow rate of the fan during typical operating conditions.

(ii) Duration: The minimum duration of the flush-out period shall be the greater of the following:

(a.) Time required for delivery of a total air volume of 14,000 cu. ft. per sq. ft. of floor area, or

(b.) Seven consecutive days.

(iii) The ventilation system shall be capable of replacing 100 percent of the air on any floor, on a minimum of two floors at a time, or as applicable to the portion of the Work.

(iv) Scheduling: Coordinate the scheduling and sequencing of the building flush-out with the Engineer.

(a.) Incorporate scheduling and sequencing into the IAQ Management Plan.

(b.) Regardless of the duration as determined above, schedule the flush-out so that it concludes within two weeks after issuance of the Certificate of Substantial Completion.

g. Perform Indoor Air Quality (IAQ) testing in accordance with the requirements of the New York State Green Building Tax Credit (GBTC), Section 638.7(d) "Indoor Air Quality", sub-section (1) "Indoor Air Quality Testing". A copy of the applicable GBTC section is available from http://www.dec.state.ny.us/website/ppu/grnbldg/index.html.

(i) Perform IAQ Testing no later than 30 days after issuance of the Certificate of Substantial Completion.

(ii) Coordinate all IAQ testing and flush-outs required by the GBTC with the Engineer.

h. Confirm that all air filters, casings, coils, fans and ducts are clean before testing-adjusting-balancing (TAB) and air quality testing. Inspect and/or clean permanent air supply ducts to comply with the minimum requirements of "General Specifications for the Cleaning of HVAC Systems" published by the National Air Duct Cleaning Association.

i. Include provisions in the IAQ Management Plan for addressing construction site conditions that do not adhere to the Plan and remedies for stopping Work, notification of the Engineer and rectifying non-compliant conditions.

5.) Filtration Media

a. If air handlers are used during construction, furnish and install filtration media at each return grill or return duct opening and achieve a Minimum Efficiency Reporting Value (MERV) of at least 8, as determined by ASHRAE 52.2-1999.

b. Replace all filtration media immediately prior to completion of Work and achieve a Minimum Efficiency Reporting Value (MERV) of 13, as determined by ASHRAE 52.2-1999.

6.) Oversee, coordinate, document and enforce the performance of all IAQ Management Plan control measures and maintenance activities at the construction site. Develop the sequence of major construction activities to include the identification, coordination, start-up date and expected duration of the control measures for each major construction activity. Review the sequence of major construction activities with each subcontractor prior to commencement of the respective subcontract Work.

7.) Assemble all drawings or other documentation related to the control measures implemented and photograph applicable control measures at regular intervals throughout the duration of the Contract for documentation purposes. Examples are photographs of ductwork sealing and protection, temporary ventilation measures and conditions of on-site materials storage (to prevent moisture damage). Photographs shall be integral date stamped and accompanied by brief descriptions, or shall reference specific meeting minutes or similar documents. Maintain a log of all ongoing maintenance activities.

8.) Submit the following to the Engineer in accordance with this clause:

a. A draft and final version of the IAQ Management Plan.

b. The sequence of major construction activities of all IAQ Management Plan control measures.

c. A Monthly IAQ Management Report, containing the following information:

(i) Contract number and title, name of company completing report and dates of period covered by the report.

(ii) Photographs that document the implementation of the IAQ Management Plan.

(iii) Meeting minutes, checklists, worksheets, notifications of deficiencies and resolution logs, etc. related to the IAQ Management Plan.

(iv) Documentation and log of duct inspection and cleaning where required.

d. Product Cut Sheets for all filtration media used during construction and furnished and installed immediately prior to completion of Work, with Minimum Efficiency Reporting Value (MERV) values highlighted. Verify on the product cut sheets that the submitted products have been installed in the completed Work.

J. Low Emitting Materials

1.) Interior Adhesives and Sealants

a. All adhesives and sealants used for interior Work of this Contract shall comply with the following standards:

(i) Adhesives (VOC Limits & Chemical Restrictions): Rule 1168 – "Adhesive and Sealant Applications," amended 1 January 2005): South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

(ii) Sealants (VOC Limits and Chemical Restrictions)

(a.) Regulation 8 (Organic Compounds), Rule 51 (Adhesive and Sealant Products), amended 17 July 2002: Bay Area Air Quality Management District (BAAQMD), State of California, www.baaqmd.gov.

(b.) Rule 1168 – "Adhesive and Sealant Applications," amended January 1, 2005): South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

b. VOC Limits for Interior Adhesives (SCAQMD, Rule 1168):

(i) The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

(a.) General: Unless otherwise specified below, the VOC content of all adhesives, adhesive bonding primers or adhesive primers shall not be in excess of 250 grams per liter.

(b.) For specified building construction related applications, the allowable VOC content is as follows:

APPLICATION	VOC LIMIT (g/L)
Architectural Applications	
Indoor carpet adhesive	50
Carpet pad adhesive	50
Ceramic tile adhesive	65
Drywall and panel adhesive	50
Cove base adhesive	50
Multipurpose construction adhesive	70
Structural glazing adhesive	100
Specialty Applications	
PVC welding	510
CPVC welding	490
ABS welding	400
Plastic cement welding	250
Adhesive primer for plastic	250
Contact adhesive	80
Special purpose contact adhesive	250
Sheet applied rubber lining operations	850
Substrate Specific Applications	
Metal to metal	30
Plastic foams	50
Porous material (except wood)	50

c. VOC Limits for Interior Sealants (SCAQMD, Rule 1168 and BAAQMD Reg. 8, Rule 51):

(i) The VOC limits defined by SCAQMD and BAAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

APPLICATION	VOC LIMIT (g/L)
Sealants	
Architectural	250
Sealant Primer	
Architectural - Nonporous	250
Architectural - Porous	775

d. Chemical Restrictions on Adhesive and Sealants (SCAQMD, Rule 1168):

(i) Chloroform.

(ii) Ethylene dichloride.

(iii) Methylene chloride.

(iv) Perchloroethylene.

(v) Trichloroethylene.

2.) Interior Paints and Coatings

a. All paints, primers and coatings used for interior Work of this Contract shall comply with the following standards:

(i) Green Seal Environmental Standard for Paints (GS-11 for opaque topcoats, GC-03 for anti-corrosive paints), Green Seal, 1001 Connecticut Avenue, NW, Suite 827, Washington, DC, 20036; http://www.greenseal.org/certification/environmental.cfm.

(ii) Rule 1113 – "Architectural Coatings," amended 7/9/04: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

b. Paints and Primers (Non-Specialized and Anti-Corrosive): Paints and primers used in non-specialized interior applications (e.g., for gypsum board, plaster, wood, metal doors and frames), and as anti-corrosive paints, shall meet the VOC and chemical component limitations of the Green Seal Paint Standards GS-11 and GC-03 respectively. Product-specific environmental requirements are as follows:

(i) Volatile Organic Compounds: The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by US Environmental Protection Agency (EPA) Reference Test Method 24. Calculation of VOC shall exclude water and tinting color added at the point of sale.

(a.) Interior Coatings:

Non-flat	150 g/L
Flat	50 g/L

(b.) Anti-Corrosive:

Gloss	250 g/L
Semi-gloss	250 g/L
Flat	250 g/L

c. Chemical Component Limits

(i) Aromatic Compounds: The product shall contain no more than 1.0 percent by weight of the sum total of aromatic compounds. Testing for the concentration of these compounds will be performed by the Engineer if they are determined to be present in the product during a materials audit.

(ii) Other Chemicals: The following chemical compounds shall not be used as ingredients in the manufacture of the product:

(a.) Halomethanes: Methylene chloride.

(b.) Chlorinated Ethanes: 1,1,1-trichloroethane.

(c.) Aromatic Solvents: Benzene, toluene (methylbenzene), ethylbenzene.

(d.) Chlorinated Ethylenes: Vinyl chloride.

(e.) Polynuclear Aromatics: Naphthalene.

(f.) Chlorobenzenes: 1,2-dichlorobenzene.

(g.) Phthalate Esters: di (2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate.

(h.) Miscellaneous Semi-volatile Organics: Isophorone.

(i.) Metals and Their Compounds: Antimony, cadmium, hexavalent chromium, lead, mercury.

(j.) Preservatives (antifouling agents): Formaldehyde.

(k.) Ketones: Methyl ethyl ketone, methyl isobutyl ketone.

(l.) Miscellaneous Volatile Organics: A crolein, acrylonitrile.

3.) Paints and other Architectural Coatings (Specialized Applications): Paints and other architectural coatings used in specialized interior applications (as defined below) shall meet the VOC limitations defined in Rule 1113, "Architectural Coatings" of SCAQMD, of the State of California. The VOC limits defined by SCAQMD, based on 7/9/04 amendments, are as follows. VOC limits are defined in grams per liter, less water and less exempt compounds.

COMPOUND	VOC LIMIT (g/L)
Bond Breakers	350
Concrete-Curing Compounds	350
Fire-Retardant Coatings - Pigmented	 350
Floor Coatings	50
Graphic Arts (Sign) Coatings	500
Industrial Maintenance (IM) Coatings - High Temperature IM Coatings - Zinc-Rich IM Primers	100 420 100
Low-solids Coatings	120
Magnesite Cement Coatings	450
Mastic Coatings	300
Metallic Pigmented Coatings	500
Multi-Color Coatings	250
Pre-Treatment Wash Primers	420
Primers, Sealers and Undercoaters	100
Quick-Dry Enamels	50
Quick-Dry Primers, Sealers and Undercoaters	100
Recycled Coatings	250
Specialty Primers	100
Waterproofing Sealers	100
Waterproofing Concrete/Masonry	

Sealers	100
Other Coating Types (not included in above)	250

4.) Carpeting: Carpeting, carpet tiles and carpet cushion shall meet or surpass all criteria of the "Green Label Plus" Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI). For carpet adhesives refer to Interior Adhesives and Sealants above.

5.) Urea-formaldehyde Free Composite Wood: All composite wood, engineered wood or agrifiber products used for interior applications (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI).

SUSTAINABLE MATERIALS CERTIFICATION FORM (SMCF)	PAGE OF
CONTRACT NUMBER AND TITLE:	SPECIFICATION SECTION:
CONTRACTOR:	SUBMITTAL NO:
DATE:	

PRODUCT	VENDOR OR MANUFACTURER	REQUIRED FOR ALL PRODUCTS IDENTIFIED IN SPECIFICATIONS (EXCEPT MEP)		RECYCLED CONTENT		% REGIONAL CONTENT MANUFACTURED[3] & EXTRACTED WITHIN 500 MILE RADIUS OF SITE (% BY WEIGHT)[4]	WOOD PRODUCTS: % FSC CERTIFIED[6]	VOC CONTENT[7] (FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS)	% RAPIDLY RENEWABLE CONTENT[8]
		TOTAL INSTALLED COST	MATERIAL COST (EXCLUDING LABOR & EQUIPMENT)	% POST CONSUMER CONTENT[1]	% POST INDUSTRIAL CONTENT[2]				
1.									
2.									
3.									
4.									
5.									
6.									

1 POST-CONSUMER RECYCLED CONTENT: Portion of material or product originating from discarded consumer waste that has been recovered for use as a raw material (e.g., plastic bottles, newspaper).

2 POST-INDUSTRIAL RECYCLED CONTENT: Portion of material or product originating from recovered industrial and manufacturing materials that has been diverted from municipal solid waste for use in a different manufacturing process, prior to use by a consumer (e.g., fly-ash in concrete or synthetic gypsum board, both being by-products of coal-burning power plants). Note that spills and scraps from the original manufacturing process combined with other constituents after a minimal amount of reprocessing for use in further production of the same product do not qualify.

3 REGIONAL EXTRACTION/MANUFACTURE: Extraction: Extraction, harvesting or recovery of materials that are used for manufacturing of products to be installed in the building. Manufacture: Final assembly of components into a finished product that is furnished and installed as part of the Contract. For example, if the lumber is from Missoula, MT, and the joist (the finished product in this case) is assembled in Kent, WA; then the location of final assembly is Kent, WA). Since Missoula, MT is within a 500 mile radius of Kent, WA the answer for this example would be '100%'.

4 PARTIAL EXTRACTION/MANUFACTURE: If a product is 100% manufactured regionally, but only a fraction of the material is

extracted/harvested/recovered within a 500 mile radius then (only) that percentage (by weight) contributes to the regional value.

5 RAPIDLY RENEWABLE: Materials and products made from raw materials that are harvested within a 10-year cycle (e.g., bamboo, cork, linoleum, fast-growing poplar, wheatboard, wool carpet).

6 FSC-CERTIFIED: Wood-based products certified by the Forest Stewardship Council and carrying a Chain-of-Custody certificate number from the vendor or manufacturer.

7 VOC CONTENT: The quantity of volatile organic compounds contained in products such as adhesives, sealants and architectural coatings. Report VOC content in grams/liter or lbs/gallon.

END OF SECTION

DIVISION 2

SECTION 02050

DEMOLITION AND DISPOSAL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for demolition and disposal.

B. Retained Items Prior to demolition, carefully remove, store and protect materials and equipment, if any, shown on the Contract Drawings as "Retain - Deliver to Engineer".

C. Additionally, for Work in the City of New York, prior to demolition employ a certified exterminator and treat entire structure in accordance with governing health regulations for rodent and insect control, as if the Work were being performed for a private corporation.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Contractor assumes the risk of any loss due to theft, destruction or disappearance of, or damage to, the structures or portions thereof to be demolished, whether occurring before or after the submission of Proposals on this Contract, arising from any cause whatsoever excepting only affirmative, intentional acts of the Authority.

B. The Authority assumes no responsibility for guarding the structures to be demolished either before or after the Contractor is given access thereto, and does not guarantee that their condition will remain the same after the submission of Proposals as before. The Authority does not imply by this Section that the structures to be demolished are complete structures.

C. Storage or sale of items of salvable value to the Contractor is prohibited on the construction site.

D. Demolition using explosive, incendiary, or wrecking ball methods is prohibited.

E. Provide water and wet down the structure(s) being demolished, as well as the sites adjacent to the structure(s) being demolished, to limit raising dust and dirt to lowest practical level. Provide water truck, water line or hydrant connection, and hoses for this purpose.

F. Do not use, or permit the use of, the structure(s) to be demolished for any purpose other than for actual demolition.

G. Do not traverse pavement with tracked vehicles or other equipment which may damage pavement.

H. Do not use heaters without prior approval of the Engineer. Installation of temporary heaters, if used, shall conform to American National Standards Institute (ANSI) A10.10 "Safety Requirements for Temporary and Portable Space Heating Devices and Equipment Used in the Construction Industry".

I. Condition of Adjacent Construction

1. Prior to starting demolition, make an inspection accompanied by the Engineer to determine physical condition of adjacent existing structure(s) or construction that is to remain.

2. During such inspection the Engineer and the Contractor shall mutually agree on existing damage to adjacent existing structure(s) or construction that is to remain, if any, and the Contractor shall subsequently prepare and submit to the Engineer a written description of such mutually agreed upon existing damage, including photographic documentation when requested by the Engineer.

J. Utility Services

1. Do not disrupt service to fire hydrants in any way without the written approval of the Engineer. If, with written approval of the Engineer, water service to any area is disrupted, make provisions to ensure adequate fire protection for such area.

2. At all times during the Work of this Section, maintain accessibility from street to all fire hydrants, traffic signals, power or light poles, mailboxes, and similar utility and public service items adjacent to the construction site.

3. Do not interrupt utilities serving occupied or used areas, except when authorized by the Engineer. Provide temporary services during such interruptions as approved by the Engineer.

4. Arrange in advance of demolition Work for disconnection or rerouting of utility line(s). Identify such capped, plugged, sealed or rerouted lines on a record drawing. Submit such drawing in accordance with 1.03.

1.03 SUBMITTALS

A. Submit the following to the Engineer prior to start of demolition Work:

1. Certificates of severance of utility services from the respective utilities;

2. For Work in the City of New York, certification that the structure has been effectively treated for rodent and insect control;

3. Description of proposed methods and operations of demolition, for review and approval by the Engineer;

4. Description of sequence of demolition and disposal Work, for review and approval by the Engineer;

5. Written inspection report described in 1.02 I.2; and

6. Description of proposed method of filtering sediment from runoff, for review and approval by the Engineer.

B. Submit in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples", of Division 1 - GENERAL PROVISIONS, a record drawing indicating horizontal and vertical locations of disconnected, rerouted or capped utilities, or filled underground tanks. Reference all such items to visible permanent surface features.

C. For imported fill material, submit to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, one 25- pound, representative sample of such material proposed for use under this Section, subject to the following:

1. Not less than three weeks prior to delivery of imported fill material to the construction site, submit sample in clean sturdy container or bag which shall not permit loss of any material.

2. Clearly label sample with Contract number, title and location, material supplier's name and location and identification of fill material.

3. Do not deliver imported fill material to the construction site until the Engineer has checked and approved the sample of such material.

PART 2. PRODUCTS

2.01 MATERIALS

A. Imported Fill Soil materials to be delivered to the construction site by the Contractor, approved in accordance with 1.03 C, shall be as follows:

1. For basements, voids and sub-base, soil materials shall consist of stone, gravel, and sand, free from debris, trash, roots and other organic matter, with no particle size exceeding 2 inches in maximum dimension.

2. For tank filling, soil material shall be clean, well-graded sand.

B. Rubble Fill Rubble fill shall be concrete, brick or other masonry materials resulting from demolition. Break fill material into pieces not exceeding 4 inches in their greatest dimension, with no flat or elongated pieces, with all protruding reinforcing cut or burned off, and with a sufficient percentage of smaller pieces to minimize voids. A flat piece is one having a ratio of width to thickness greater than five; an elongated piece is one having a ratio of length to width greater than five.

PART 3. EXECUTION

3.01 PREPARATION

A. Protection

1. Erect and maintain temporary window or opening covers, covered passageways, barricades or fences as required to ensure safe passage of persons around area of demolition.
2. Erect and maintain enclosed dust chutes as required for the disposal of materials, rubbish, and debris.
3. Erect and maintain dustproof partitions as required to prevent spread of dust, fumes or smoke to other occupied or used areas or structures.
4. ensure that movement or settlement of structures to be demolished is safely controlled and collapse is prevented. Ensure that movement, settlement, and/or damage to existing facilities does not occur.

B. Pollution Controls

1. Use water sprinkling, enclosed chutes and/or temporary enclosures to limit dust and dirt rising and scattering in the air. Conform to requirements of 1.02 E.
2. Filter sediment from runoff before it enters drainage systems or waterways using methods in accordance with 1.03 A.6.
3. Do not use water when it may create hazardous or objectionable conditions such as ice or flooding.
4. Pump out the contents of buried tanks shown on the Contract Drawings. Remove such pumped-out materials and dispose of them away from Authority property by safe means so as not to endanger the health of workers and the public.

C. Authority-Retained Items

1. Remove and handle carefully to avoid damage.
2. Prepare as shown on the Contract Drawings.
3. Deliver to a construction site location designated by the Engineer, unless otherwise shown on the Contract Drawings.

3.02 DEMOLITION

A. Conduct demolition operations and disposal of debris to ensure minimum interference with the use of, or access to, adjacent buildings or construction site areas. Do not unnecessarily obstruct sidewalks or street.

B. Before commencement of demolition remove all glass in windows, doors, skylights and fixtures.

C. Proceed with demolition in a systematic manner, from top of structure to ground. Complete upper demolition before disturbing lower supporting members.

D. Do not store any materials, rubbish, dirt, debris or waste of any sort resulting from the demolition operations on the floor of partially demolished structures, or adjacent construction site areas.

E. Demolish concrete and masonry in small sections. Lower heavy framing members carefully.

F. Where shown on the Contract Drawings, break and remove on grade and basement slabs.

G. Disposal of Demolished Materials

1. Unless otherwise shown on the Contract Drawings, dispose of debris, rubbish, and other materials resulting from demolition operations away from Authority property.

2. On Authority property, do not burn, bury or otherwise dispose of debris, rubbish or other materials resulting from demolition operations.

H. Contractor's Salvaged Materials Except for items shown on the Contract Drawings as "Retained - Deliver to Engineer", other removed and salvaged materials not shown for reuse or as retained shall become the Contractor's property. Such materials shall be removed from Authority property at no additional cost to the Authority.

3.03 ADJUSTMENTS

A. Unless otherwise shown on the Contract Drawings, provide fill for below-grade areas and voids resulting from the Work of this Section as follows:

1. Fill to be placed one foot or more below grade or paving subgrade, or one foot or more away from foundation walls, edges of footings, or underground utility lines, may at the Contractor's option, be imported soil material or rubble fill as specified in 2.01.

2. Fill to be placed in the remaining one-foot void shall be approved imported soil material conforming to requirements of 2.01 A.1.

B. Place approved rubble fill material in horizontal layers not exceeding one foot in loose depth, with top layer consisting of the smallest size rubble available. Compact each layer of rubble fill with at least four passes of a ten-ton roller, of a type approved by the Engineer.

C. Place approved imported soil materials in horizontal layers not exceeding 6 inches in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, unless otherwise directed by the Engineer.

D. Unless otherwise shown on the Contract Drawings, fill buried tanks with approved imported sand conforming to requirements of 2.01 A.2.

E. After placement and compaction of fill, grade surface to meet adjacent contours and to provide surface drainage.

F. Where and as shown on the Contract Drawings, provide for subsurface drainage through slabs on which fill is placed.

3.04 REPAIR

Promptly repair, to the satisfaction of the Engineer and at no cost to the Authority, damage caused to adjacent facilities by demolition and removal operations.

END OF SECTION

SECTION 02050

DEMOLITION AND DISPOSAL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. General Use this Section only when the complete demolition and disposal of a structure is required and there are no occupied structures attached to or in the immediate vicinity of the structure to be demolished.

B. Modifications Required in the Contract Documents ("FRONT END")

1. In Long Form Contracts which include demolition Work on plates 55 or 55A as appropriate, add subparagraph (b) in accordance with Long Form Instructions.

2. In Short Form Contracts which include demolition Work, revise (a) of Clause 8 of the PROPOSAL as follows: After "construction" delete the closing parenthesis and insert "and damage to or alterations of the structure to be demolished occurring prior to the issuance of the certificate of final completion, without additional cost to the Authority and without compensation for lost salvage value)".

3. If asbestos removal is to be performed under another Specification Section of the same Contract, it must be completed prior to start of Work of this Specification Section. Therefore, insert the following in the Division 1 Section of the "Front End" entitled "Conditions and Precautions", "PATH Operations and Conditions" or "Airport Operations and Conditions", as appropriate: Prior to start of demolition and disposal Work under this Contract, Contractor shall verify that all asbestos removal Work under this Contract is complete.

C. Contract Drawings

1. Ensure that the Contract Drawings show:

a. Extent of structure(s) to be demolished including the depth of below grade portions (3.03 A)

b. Items that the Authority will retain (salvage). Identify such items "Retain - Deliver to Engineer" (1.01 B and 3.02 H). Show locations to where Authority - Retained Items are to be delivered - if other than a construction site location. Also, ensure that specific wrappings or crating preparation, if any, are described (3.01 C.2)

c. Locations of water connections, if any (1.02 E)

d. Location(s), sizes(s) and identification of all known utility lines (1.02 J)

e. Location(s), sizes(s) and identification of stored materials in buried tanks (2.01 A.2, 3.01 B.3 and 3.02 D)

f. Extent of slabs to be removed (3.02 F)

g. Location(s) of on-site spoil areas for disposal of rubble, if any (3.02 G)Existing items to be reused, if any (3.02 H)

h. If cut-off piles are in Work, show cut-off elevation and method of pile protection at cut-off.

i. Extent and type (breaking, coring, etc.) of preparation to provide for subsurface drainage through existing concrete slabs to remain below fill (3.02 F).

D. Other Items

1. The Code of Federal Regulations, 40 CFR Part 280, has specific EPA testing and reporting requirements related to underground tanks. If work of the contract includes abandonment and filling or removal of underground tanks, notify the Environmental Unit to determine if there any requirements other than tank draining and sand filling.

2. The full extent of Work specified in this Section should be shown on the Contract Drawings. Where this is not possible for the Work specified, particularly in 1.02 J.3 or in other parts of this Section, provision for "Net Cost" must be added as Part 4 to the Section and items of Work for which "Net Cost" will apply must be shown on the Contract Drawings.

3. Ensure that Structural Task Leader has reviewed foundation conditions and Geotechnical Task Leader has reviewed soil conditions at structures to be demolished and adjacent or adjoining structures to determine whether conventional shoring, bracing, and/or support methods are adequate, as specified in 3.01 A.4 of this Section. If it is determined that additional means must be employed to ensure that movement, settlement, and/or damage to adjacent or adjoining structures does not twice place, ensure that such methods are adequately shown on the Contract Drawings.

4. If the demolition Work specified in this Section is located on the waterfront and/or there exists the possibility that debris and contaminants may enter waterways; and methods and controls specified in 3.01 B.2 are not adequate to prevent such occurrence. Show appropriate containment methods on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 2

SECTION 02051

APPROACH STRUCTURE DEMOLITION AND DISPOSAL

PART 1. GENERAL

1.01 SUMMARY

A. This work shall consist of demolition, removal, and proper disposal, in stages, of the existing approach superstructure, substructure, toll plaza, approach ramps and grade slabs as shown in the Contract Drawings and as directed by the Engineer. The Contractor shall conform to all applicable codes and regulations of agencies having jurisdiction over this work.

B. The work shall also include: demolition and disposal of bituminous overlay, obsolete utility lines, concrete median barriers, fascia barriers, light poles, sign structures, and backfilling resulting trenches, tunnels, holes and pits.

C. All full depth saw cutting of existing and temporary deck required for stage construction as shown in the Contract Drawings is also included under this section.

D. All flame or torch cutting to remove the existing and temporary structures shall also be included under this section.

E. The work shall also include removal of existing electrical rooms as shown in the Contract Drawings.

F. The work shall also include removal of existing stairs as shown in the Contract Drawings.

G. The work shall also include removal of any existing electrical/lighting/ communications facilities on the existing structure which are not required for final conditions as shown in the Contract Drawings, noted in the specification, or as directed by the Engineer.

H. Portions of the work under this section may require to be carried out during the night time.

1.02 RELATED SECTIONS

A. Section 02050 Demolition and Disposal

B. Section 02073 Cutting Patching and Removal

C. Section 02075 Partial Removals

D. Section 02221 Excavation, Backfilling and Filling

E. Section 02251 Approach Temporary Shoring System

1.03 REFERENCES

A. Safety and Health Regulations for Construction (OSHA).

B. New York State Department of Transportation Standard Specifications, Construction and Materials (US Customary), dated May 1, 2008 with current additions and modifications.

NOTE: In the various subsections of the NYSDOT Standard Specifications referenced in this specification, references to "The Department" shall be taken to mean The Port Authority of New York and New Jersey (Authority), references to "The Regional Construction Engineer", or "Deputy Chief Engineer" shall be taken to mean The Port Authority of New York and New Jersey Engineer (the Engineer).

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Backfill – See Section 02221 Excavation, Backfilling and Filling, for backfill material requirements.

PART 3. EXECUTION

3.01 GENERAL

A. The Contractor shall conduct all demolition operations in a safe, legal, and responsible manner and shall ensure that any equipment, material, or method used shall be safe for the workers and the public. All laws, rules, regulations, and local building codes shall be followed. Local building code shall mean the New York City Building Code or bodies at least as stringent in its requirements as the "New York State Fire Prevention and Building Code" and its associated reference standards, or similar codes applicable to areas on the portion of structure located in the State of New Jersey.

B. Prior to demolition operations, an engineering survey shall be made by a competent person of the bridge approach, buildings and other structures to determine their condition and the possibility of collapse of any portion, as outlined in 29 CFR 1926, Subpart T. As defined in 29 CFR 1926, Subpart C "Competent Person" means someone employed by the Contractor who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are or will be unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them. For purposes of this contract a competent person shall mean a New York State and a New Jersey State registered Professional Engineer experienced in bridge design, construction and demolition of such structures. The qualifications of the competent person shall be submitted to the Engineer for review and approval.

C. Adjacent buildings or structures, within 100 feet of the existing structure to be removed, shall also be included in the engineering survey, if directed by the Engineer. The findings and recommendations of this engineering survey shall constitute a "Removal Plan." See Subsection 3.01B above, and shall be submitted to the Engineer for review, prior to the start of such work. The Removal Plan shall be submitted to the Engineer thirty (30) days prior to the commencement of demolition.

D. The Engineer may return the Removal Plan and require additional engineering surveys and studies to be conducted if the Removal Plan does not adequately identify and address obvious safety and other identified conditions. However, the Engineer's failure to return any Removal Plan for additional studies and recommendations shall not relieve the Contractor from the obligation of preparing an adequate Removal Plan and conducting adequate engineering surveys that safeguard the workers and public.

E. The Contractor's responsible competent person shall frequently and on a continuing basis perform monitoring to reassess the structural condition of the surveyed structures. This shall be accomplished by observing them for the presence of excessive vibrations; measuring and recording the width, extent, and progression of cracks; by measuring and recording the plumbness and integrity of structural elements and bracing; and by making other observations as necessary. Should the results of these assessments indicate that potential for collapse of a structure or building to be demolished exists; the competent person shall recommend and cause measures to be taken to ensure safety. Should the results of these assessments indicate that the work is causing damage to or diminution of structural condition of a structure that is to remain, either wholly or in part, or one that is to be relocated, the competent person shall recommend and cause to be undertaken measures to prevent additional damage or diminution of structural condition from occurring, and if directed by the Engineer, shall recommend and cause to be undertaken measures necessary to reverse the diminution or repair the damage. The findings and recommendations of these monitoring assessments shall be made part of the Removal Plan prepared for the work and shall be provided to the Engineer promptly.

F. The Removal Plan shall include a description of the type, size, weight, and location of all equipment to be used and the sequence of removal activities. The Contractor shall prepare and submit shop drawings and calculations, signed and sealed by a New York State and a New Jersey State registered Professional Engineer demonstrating that his equipment, placement and demolition and disposal operations sequence do not transmit loads that overstress temporary or existing structures.

G. Calculations, shop drawings, and specifications for the design of the temporary protective devices, temporary support, bracing and lifting operations, as required, shall also be submitted to the Engineer for his review along with the Contractor's proposed Removal Plan. All calculations, shop drawings and specifications shall be stamped and signed by a registered Professional Engineer currently licensed in the State of New York and New Jersey.

H. Before any structure served with or having utilities thereon is demolished all telephone, cable, electric, gas, water, steam, or any other service shall be shut off and capped, or otherwise made safe and controlled off the structure before the general demolition work is started. Remediation work of asbestos or other hazardous material however may proceed before services are cut, except that all electric circuitry in any work area that is humid, wet, or will become wet or humid during the work, shall be shut down and locked out. If power is required in such places, temporary power and light circuits may be brought into the work area provided such circuits have ground fault interrupters at their sources. In each case, the utility companies involved shall be notified, in writing, at least five (5) working days, or longer if indicated elsewhere in the contract documents, in advance of the work. The Contractor shall be held fully responsible for any claim arising from failure to do so.

I. All severed sewer lines or drains emanating from the structure shall be capped or otherwise tightly sealed to prevent the entry of foreign materials into the main sewer or drain.

J. The Contractor shall protect power, water, communications, lighting or other utility lines during demolition. If such lines cannot be protected in place they shall be temporarily relocated, as necessary, and protected prior to undertaking any demolition work that might affect them. The Contractor shall notify the respective utility company owning the utility with proper notice and coordinate all utility relocation work with the respective owner.

K. During the periods that personnel are required to work on, in, or around a structure to be demolished which is in a damaged or deteriorated condition by fire, flood, explosion, weather, or other cause, its elements shall be adequately braced to prevent collapse.

L. All asbestos materials or other hazardous materials shall be removed from or otherwise remediated on each structure before the general demolition work on that structure begins. The requirements and payment for this work will be as indicated elsewhere in the contract documents and as outlined in the asbestos or hazardous material remediation plan prepared by the Authority or others for the project.

M. Where a falling hazard exists to personnel, the openings shall be protected to a height of approximately 3 feet. All floor or deck openings not used as material drops shall be covered over with materials substantial enough to support the weight of any loads which may be imposed upon them. Such materials shall be properly secured to prevent accidental movement.

N. When excavation is required, the Contractor shall provide excavation protection for workers and the public in accordance with NYSDOT Specification Section 107-05K, Open Excavation and Trenches.

O. The Contractor shall repair or replace in kind, at no cost to the Authority and in a manner as approved by the Engineer, curbs, roadway and other materials designated to remain in place for subsequent construction stages which are damaged by or as a result of the work.

P. The Contractor shall provide colored tapes, barricades, marking paint, and signs which shall be used to mark all areas that could become subject to collapse or that could become unstable as a result of demolition activity. Such areas are to be designated as non-access areas, and are to be identified by the previously mentioned Engineering Survey. Non-access areas shall be identified by means as approved by the Engineer.

Q. Personnel and equipment with operators on board shall remain outside these designated non-access areas at all times during demolition operations or at any time the area is subject to collapse.

R. During the course of demolition work, the Contractor shall continue to monitor the structure by a competent person, and the designated non-access areas or any additional non-access areas identified during the course of the work shall be appropriately marked and signed.

S. Steel and other metals other than those embedded in concrete or otherwise inseparable from articles being discarded shall be disposed of in a manner that ensures their salvage for recycling.

T. For steel structures coated with lead-based paint, the Contractor shall comply with the provisions of 29 CFR 1926.62 and all other applicable worker Health and Safety Regulations. In addition, the Contractor shall comply with all applicable regulations controlling the release of lead-based paint into the environment. Prior to the beginning of any steel removal operations, the paint shall be removed for a minimum distance of four inches on each side of the centerline of cut, bolt row, or weld as applicable.

U. The paint removal work and handling/disposal of all painted steel being removed shall be done in accordance with Specification Section 02082 requirements.

V. During the staged removal/demolition of the approach superstructure, the Contractor shall provide a barrier to delineate the construction zone from the active roadway, such as fencing and roadway barriers to prevent unauthorized personnel from entering the construction zone.

W. The work under this section shall also include using shielding to also protect the public, project personnel, the existing structure, and adjacent property as necessary in order to progress the demolition required under this contract.

X. The Contractor must obtain permit from the Authority for any operation during the demolition operations that requires any roadway or lane closure of the Bayonne Bridge.

3.02 REMOVING EXISTING SUPERSTRUCTURE

A. The Contractor shall demolish the existing structures in accordance with Section 3.01 - General and the following: All concrete and paving material shall be removed from the structure and shall be disposed of by the Contractor in a manner in accordance with laws, rules or regulations, any provision found elsewhere in the contract documents, and as approved by the Engineer.

B. The rest of the material removed under this work will become the property of the Contractor and shall be removed from the site of the work and disposed of in a manner approved by the Engineer.

C. Removal of superstructure shall also include, but not be limited to, the removal of slabs, beams, bearings, obsolete utility lines, drainages, electrical and mechanical systems, light poles, room enclosure, stairs, fascia barriers, median barriers and curbs as shown in the Contract Drawings or as approved by the Engineer, and in accordance with all Federal, State, and local laws, rules and regulations and any provisions found elsewhere in the contract documents. Removal of existing deck slabs may include full depth saw cutting.

D. The Contractor shall prepare and submit calculations, signed and sealed by a New York State and a New Jersey State registered Professional Engineer demonstrating that his equipment and demolition operations sequence do not transmit loads that overstress temporary or the existing superstructures. For superstructure demolition, include in the calculations the following, but not necessarily limited to:

1. Capacity chart for each crane and boom length used in the work.
2. Pick point location(s) on each member.
3. Lifting weight of each member (including clamps, spreader beams, etc.).
4. Lift and setting radius for each pick (or maximum lift radius).
5. Complete description of lifting devices or other connecting equipment.
6. Location of lifting equipment and trucks for removing demolished items.

E. The Contractor shall exercise care while removing the unsound concrete so as not to damage materials which are to remain in place.

F. Care shall be taken to ensure that the structural steel members and concrete that are still in use are not damaged due to the Contractor's operations. Should a structural member be damaged due to the Contractor's operations, the damaged portion of the structure shall be repaired at no additional cost to the Authority. The Engineer shall be the sole judge as to whether or not the structural member may be in need of repair.

G. Care shall be taken to ensure that the new structures are not damaged due to the Contractor's operations.

H. Chipping hammers if used by the Contractor shall meet the following requirements:

1. Chipping hammers shall weigh no more than 45 lbs with the bit, and the muffler shall not be removed.
2. The hammer shall deliver no more than 1600 blows per minute.
3. The Contractor shall submit to the Engineer information from the hammer manufacturer that these requirements are not exceeded.
4. The air pressure used to power the hammer shall not exceed 100 psi measured at the air compressor. An air pressure gauge in proper working condition shall be provided.
5. Only sharp chisel point bits, a minimum of 2 inch wide, shall be used. All bits determined by the Engineer to be dull shall be sharpened or replaced.
6. If the Engineer determines that the Contractor's operations are resulting in damage to concrete that is to remain, the Contractor shall make immediate corrections. These corrections shall include the use of a lighter chipping hammer if so ordered by the Engineer.

I. The Contractor shall conform to the following requirements while saw cutting the concrete deck:

1. An approved power saw with diamond blades shall be utilized to cut reinforced concrete deck to the configuration and full depth as specified in the Contract Drawings or as directed by the Engineer.
2. Sawcutting for deck removal shall be along a neat line as shown in the Contract Drawings or as directed by the Engineer. After the deck has been cut to its full depth, the Contractor may use pry bars or other methods approved by the Engineer to pry loose the material to be removed.
3. Care shall be taken not to disturb or damage existing deck or floor system scheduled to remain as part of staged construction. Any existing deck, stringers and floor system to remain which are damaged through the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost to the Authority.

3.03 REMOVAL OF SUBSTRUCTURES

A. The holes that are a result of removing the existing substructure shall be backfilled with suitable excavated material placed in lifts and compacted to the satisfaction of the Engineer.

B. The existing substructure shall be removed to a depth of 2 feet below the final grade.

C. Removal of substructure items shall also include: partial removal of existing concrete and columns, foundations, retaining walls and footings in conflict with proposed foundations as shown in the Contract Drawings, or as approved by the Engineer.

D. Demolition of the above grade portion of the existing substructures shall be accomplished with a diamond wire saw in order to limit noise. Subsequent onsite "rubblization" of larger sawn portions shall not be permitted.

E. Demolition includes complete removal and disposal of the Toll Plaza.

END OF SECTION

SECTION 02051

STRUCTURE DEMOLITION AND DISPOSAL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of Specification Division 1 - GENERAL PROVISIONS:

Submittals shall comply with the provisions of "Shop Drawings, Catalog Cuts and Samples" per Specification Division 1.

A. Removal Plan: The Contractor shall submit to the Engineer for approval, a detailed "Removal Plan" prepared by a registered Professional Engineer currently licensed in the State of New York and New Jersey. The Removal Plan shall be submitted to the Engineer thirty (30) days prior to the commencement of demolition. The Removal Plan shall include the engineering survey.

The Removal Plan shall also be coordinated and filed with the Project Safety and Health Plan.

B. Qualifications: The qualifications of the Contractor's competent person performing the engineering survey for the Removal Plan shall be submitted to the Engineer for review and approval.

C. Shop Drawings, Calculations, Catalog Cuts, and Product Data: The Contractor shall prepare and submit calculations, signed and sealed by a New York State and a New Jersey State registered Professional Engineer demonstrating that his equipment, demolition operations and sequence do not transmit loads that will overstress the temporary or existing structures. This submittal shall be coordinated with the Removal Plan.

Include catalog cuts, manufacturers and product information and data.

For example, for superstructure demolition, submit the following, but not necessarily limited to:

1. Capacity chart for each crane and boom length used in the work.
2. Pick point location(s) on each member.
3. Lifting weight of each member (including clamps, spreader beams, etc.).
4. Lift and setting radius for each pick (or maximum lift radius).
5. Complete description of lifting devices or other connecting equipment.
6. Location of lifting equipment and trucks for removing demolished items.

D. Shop Drawings, Specifications and Calculations: The Contractor shall his designs for the temporary protective devices, temporary support, bracing and lifting operations, as required, to the Engineer for review and approval. All shop drawings, specifications and calculations shall be stamped and signed by a registered Professional Engineer currently licensed in the State of New York and New Jersey. This submittal shall be coordinated with the Removal Plan.

E. Safety Measures: The Contractor shall submit his safety measures including signs, debris shields, lead abatement, construction noise and lights, and the necessary coordination with the Authority for safety protection to the Engineer for review and approval. Include catalog cuts, manufacturers and product information and data.

F. Utility Protection Methods: The Contractor shall submit his proposed methods of protecting existing utilities, during the demolition work to the Engineer for review and approval. Include catalog cuts, manufacturers and product information and data. This submittal shall be coordinated with the Removal Plan.

G. Permits: The Contractor must obtain permit from the Authority for any operation during the demolition operations that requires any roadway or lane closure of the Bayonne Bridge.

END OF APPENDIX "A"

DIVISION 2

SECTION 02073

CUTTING, PATCHING AND REMOVAL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for cutting, patching and removal of existing construction.

1.02 QUALITY ASSURANCE

A. Cutting, patching and removal shall be performed by workers skilled in the specific trades involved.

B. Site Conditions

1. Except for portions shown to be relocated or retained by the Authority, remove and transport off Authority property all portions of the existing construction shown on the Contract Drawings to be removed in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".
2. All construction debris shall become the Contractor's property.
3. Prior to start of Work, make an inspection accompanied by the Engineer to determine physical condition of adjacent construction that is to remain.

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

All materials required for patching shall be new. Patching materials shall match in every respect adjacent portions of the existing construction unless otherwise shown on the Contract Drawings.

PART 3. EXECUTION

3.01 PROTECTION

A. Protect existing adjacent surfaces to remain and finished surfaces at all times and repair or replace, if damaged, at no cost to the Authority and to the satisfaction of the Engineer.

B. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

3.02 CUTTING, PATCHING AND REMOVAL

A. Perform all cutting, patching and removal as shown on the Contract Drawings. Work shall be performed in accordance with the approved methods using approved materials.

B. Do not cut or remove more than is necessary to accommodate the new construction or alteration.

C. Maintain the integrity of all construction at all times.

D. Do not allow removed materials and debris to accumulate at the construction site; remove them at the end of each work period or daily. All areas adjacent to, and leading to and from the site shall be kept free of removed materials and debris.

E. Do not burn, bury, or dispose of in storm drains, wetlands or waterways on Authority property debris of any type.

F. Dispose of debris resulting from removal operations in accordance with all local laws and regulations that would apply if the Authority were a private corporation.

END OF SECTION

SECTION 02073

CUTTING, PATCHING AND REMOVAL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

02073D01 Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey, 07310-1397, for approval, all product data sheets for the materials to be used for patching.

Construction and Installation Procedures

02073G01 Submit to the Engineer plans, methods, equipment and procedures as applicable for cutting, patching and removal.

END OF APPENDIX "A"

DIVISION 2

SECTION 02075

PARTIAL REMOVALS

PART 1. GENERAL

1.01 SUMMARY

This Section requires the selective removal and subsequent offsite disposal of portions of the existing building as shown on the Contract Drawings and as required to accommodate new construction.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Authority assumes no responsibility for guarding the removal areas either before or after the Contractor is given access thereto, and does not guarantee that their condition will remain the same after the submission of Proposals as before.

B. Storage or sale of items of salvageable value to the Contractor is prohibited on the construction site.

C. Removal using explosive, incendiary or wrecking ball methods is prohibited.

D. Provide water and wet down the removal areas, as well as the sites adjacent to the portions of structure(s) being removed; to limit raising dust and dirt to lowest practical level. Provide water truck, water line or hydrant connection, and hoses for this purpose.

E. Do not traverse pavement with tracked vehicles or other equipment which may damage pavement.

F. Do not use heaters without prior approval of the Engineer. Installation of temporary heaters, if used, shall conform to American National Standards Institute (ANSI) A10.10 "Safety Requirements for Temporary and Portable Space Heating Devices and Equipment Used in the Construction Industry".

G. Condition of Adjacent Construction

1. Prior to starting removal work, make an inspection accompanied by the Engineer to determine physical condition of adjacent existing structure(s) or construction that is to remain.

2. During such inspection the Engineer and the Contractor shall mutually agree on existing damage to adjacent existing structure(s) or construction that is to remain, if any, and the Contractor shall subsequently prepare and submit to the Engineer a written description of such mutually agreed upon existing damage, including photographic documentation when requested by the Engineer.

H. Utility Services

1. Do not disrupt service to fire hydrants in any way without the prior written approval of the Engineer. If, with written approval of the Engineer, water service to any area is disrupted, make provisions to ensure adequate fire protection for such area.

2. At all times during the Work of this Section, maintain accessibility from street to all fire hydrants, traffic signals, power or light poles, mailboxes, and similar utility and public service items adjacent to the construction site.

3. Do not interrupt utilities serving occupied or used areas, except when authorized by the Engineer. Provide temporary services during such interruptions as approved by the Engineer.

4. Arrange with the Engineer in advance of removal Work for disconnection or rerouting of utility line(s). Identify such capped, plugged, sealed or rerouted lines on a record drawing. Submit such drawing in accordance with 1.03 B.

I. Occupancy: The Authority will occupy portions of the building immediately adjacent to areas of selective removals. Conduct selective removal Work in manner that will minimize need for disruption of the Authority's normal operations. Provide minimum of 72 hours advance notice to the Authority of removal activities that will affect the Authority's normal operations.

J. Flame Cutting: Do not use cutting torches for removal until Work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

1.03 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Imported Fill

Soil materials to be delivered to the construction site by the Contractor, approved in accordance with 1.03C, shall be as follows:

For basements, voids and subbase, soil materials shall consist of stone, gravel, and sand, free from debris, trash, roots and other organic matter, with no particle size exceeding 2 inches in maximum dimension.

B. Rubble Fill

Rubble fill shall be concrete, brick or other masonry materials resulting from removals. Break fill material into pieces not exceeding 4 inches in their greatest dimension, with no flat or elongated pieces, with all protruding reinforcing cut or burned off, and with a sufficient percentage of smaller pieces to minimize voids. A flat piece is one having a ratio of width to thickness greater than five; an elongated piece is one having a ratio of length to width greater than five.

PART 3. EXECUTION

3.01 PREPARATION

A. Protection

1. Erect and maintain temporary window or opening covers, covered passageways, barricades or fences as required to ensure safe passage of persons around area of removals.
2. Erect and maintain enclosed dust chutes as required for the disposal of materials, rubbish, and debris.
3. Erect and maintain dustproof partitions as required to prevent spread of dust, fumes or smoke to occupied portions of the building and adjacent buildings. Where selective removals occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 1/2-inch fire-retardant plywood on both sides.
4. Provide weatherproof closures for exterior openings and for roof areas with exposed, unprotected edges resulting from removals Work.
5. Provide temporary interior and exterior shoring, bracing and/or support as required to ensure that movement or settlement of portions of structures to be removed is safely controlled and collapse is prevented. Ensure that movement, settlement, and/or damage to existing facilities does not occur.
6. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to the Engineer if shutdown of service is necessary during changeover.

B. Pollution Controls

1. Use water sprinkling, enclosed chutes and/or temporary enclosures to limit dust and dirt rising and scattering in the air. Conform to requirements of 1.02 D.
2. Filter sediment from runoff before it enters drainage systems or waterways using methods approved by the Engineer following submittal in accordance with 1.03 A.4.
3. Do not use water when it may create hazardous or objectionable conditions such as ice or flooding.

3.02 REMOVALS

A. Conduct selective removals Work and disposal of debris to ensure minimum interference with the use of, or access to, adjacent occupied areas, adjacent buildings, or construction site areas. Do not unnecessarily obstruct sidewalks or street.

B. Remove all glass in windows, doors, skylights and fixtures before proceeding with other required removal Work.

C. Proceed with removals in a systematic manner, from top of structure to ground. Complete upper removals before disturbing lower supporting members.

D. Do not store any materials, rubbish, dirt, debris or waste of any sort resulting from removal Work on the floor of areas to remain or adjacent construction site areas.

E. Remove concrete and masonry in small sections. Lower heavy framing members carefully.

F. Where shown on the Contract Drawings, break and remove on grade and basement slabs.

G. Disposal of Removed Materials

1. Unless otherwise shown on the Contract Drawings, dispose of debris, rubbish, and other materials resulting from removal operations away from Authority property.

2. On Authority property, do not burn, bury or otherwise dispose of debris, rubbish or other materials resulting from removal operations.

H. Contractor's Salvaged Materials

Removed and salvaged materials not shown for reuse or as retained shall become the Contractor's property. Such materials shall be removed from Authority property at no additional cost to the Authority.

3.03 ADJUSTMENTS

A. Unless otherwise shown on the Contract Drawings, provide fill for below-grade areas and voids resulting from the Work of this Section as follows:

1. Fill to be placed one foot or more below grade or paving subgrade, or one foot or more away from foundation walls, edges of footings, or underground utility lines, may at the Contractor's option, be imported soil material or rubble fill as specified in 2.01.

2. Fill to be placed in the remaining one-foot voids shall be approved imported soil material conforming to requirements of 2.01 A.1.

B. Place approved rubble fill material in horizontal layers not exceeding one foot in loose depth, with top layer consisting of the smallest size rubble available. Compact each layer of rubble fill with at least four passes of a ten-ton roller, of a type approved by the Engineer.

C. Place approved imported soil materials in horizontal layers not exceeding 6 inches in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, unless otherwise directed by the Engineer.

D. After placement and compaction of fill, grade surface to meet adjacent contours and to provide surface drainage.

3.04 REPAIR

Promptly repair, to the satisfaction of the Engineer and at no cost to the Authority, damage caused to adjacent construction by removal operations.

END OF SECTION

SECTION 02075

PARTIAL REMOVALS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02075A01 Submit in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples", of Division 1 - GENERAL PROVISIONS, a record drawing indicating horizontal and vertical locations of disconnected, rerouted or capped utilities. Reference all such items to visible permanent surface features.

Samples

02075C01 For imported fill material, submit to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, one 25- pound, representative sample of such material proposed for use under this Section, subject to the following:
1. Not less than three weeks prior to delivery of imported fill material to the construction site, submit sample in clean sturdy container or bag which shall not permit loss of any material.
2. Clearly label sample with Contract number, title and location, material supplier's name and location and identification of fill material.
3. Do not deliver imported fill material to the construction site until the Engineer has checked and approved the sample of such material.

Construction and Installation Procedures

02075G01 Description of proposed methods and operations of removal, for review and approval by the Engineer;

02075G02 Description of sequence of removal and disposal Work, for review and approval by the Engineer;

02075G03 Description of proposed method of filtering sediment from runoff, for review and approval by the Engineer.

Inspection Reports

02075O01 Written inspection report described in 1.02 G.2

END OF APPENDIX "A"

DIVISION 2

SECTION 02081

ASBESTOS REMOVAL AND DISPOSAL FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for removal and disposal of asbestos-containing materials and/or asbestos-contaminated objects from facilities owned and/or operated by the Port Authority of New York and New Jersey or The Port Authority Trans-Hudson Corporation (PATH), hereinafter called the "Authority" at facilities in the States of New York and / or New Jersey.

B. This Section is organized as follows:

Parts 1 through 3 represent the general portions of the specification. These sections are supplemented with Appendixes "A", "B" and "C" based on project specific abatement tasks for the State in which the work is to be performed (New York or New Jersey).

C. In accordance with Appendixes "A", "B" and "C" herein and the Contract Drawings, perform the following:

1. Prepare the "Work Area" for the removal of asbestos materials.

2. Remove, package, transport and dispose of the type(s) of asbestos-containing materials and/or asbestos-contaminated objects from the "Work Area(s)".

3. Decontaminate and seal surfaces in contact with asbestos-containing materials.

4. If removed materials are to be replaced, new materials shall be approved non-asbestos materials.

5. Re-establish "Work Area" and/or "Work Site" systems and objects.

D. Transport asbestos-containing materials and/or asbestos contaminated objects in accordance with 1.04 A.2 herein.

E. Dispose of asbestos-containing materials and/or asbestos contaminated objects at an approved landfill in accordance with 1.04 A.3 herein.

1.02 REGULATORY COMPLIANCE

A. Unless specifically directed otherwise by the Engineer, the Authority shall be sole entity to administer the regulatory compliance, the Work of this Section, and enforce the provisions herein.

B. Notifications

1. The Authority will notify the U.S. EPA for Work of this Section in accordance with 40 CFR Part 61, Section 65 (a)(b), for asbestos-containing materials.

2. The Contractor shall make arrangements for, and ensure that, the entity performing the Work of this Section performs the following:

   a. As directed by the Engineer, comply with the notification and re-notification requirements for the State in which Work is being performed and provide proof of notification and re-notification prior to starting or continuing with Work.

C. In accordance with the requirements of the Section of Division 1 – GENERAL PROVISIONS, Entitled "Laws and Ordinances," Work under this Section shall conform to the provisions of the following codes and regulations, except where otherwise noted herein or on the Contract Drawings. Where the requirements of this Section or the Contract Drawings and the following codes and regulations differ, the stricter requirements shall control. Where methods or procedures are specified, they shall constitute minimum measures and shall in no way relieve the contractor of sole responsibility for the means, methods, techniques, sequences, or safety measures in connection with the Work.

1. For Work of this Section performed in New York State:

   a. Part 56 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York: (12 NYCRR, Part 56) - Industrial Code Rule 56 ASBESTOS.

   b. 6 NYCRR Chapter II Title, 10, Part 73 - Asbestos Safety Program Requirements.

   c. 6 NYCRR, Part 364 - Waste Transporter Permits.

   d. 6 NYCRR, Part 360 - Solid Waste Management Facilities (if disposal site is in New York State).

   e. Administrative Code of the City of New York Section 755 (2) - 6.3 - Transport, Storage and Disposal of Waste Containing Asbestos, and Section B32 - 267.0 et. seq. - Commercial Refuse Removal.

2. For Work of this Section performed in New Jersey:

   a. New Jersey Administrative Code (N.J.A.C.): Section 5:23-8, Subchapter 8 - Asbestos Hazard Abatement Subcode.

   b. Section 7:26 - Division of Waste Management Rules.

   c. Section 8:60 - Department of Labor Asbestos Certifications.

   d. Section 12:120 - Safety and Health Standards.

3. For Work of this Section performed in New York State and/or New Jersey:

a. 29 CFR (Code of Federal Regulations) Part 1926.1101, U.S. Occupational Safety and Health Administration (OSHA) - Asbestos Standard for the Construction Industry.

b. 29 CFR 1910.134 – OSHA, Respiratory Protection

c. 29 CFR 1910.146 - OSHA, Confined Space Entry.

d. 29 CFR 1926.20 – OSHA, General Safety and Health Provisions.

e. 29 CFR 1926.21 – OSHA, Safety Training and Education.

f. 29 CFR 1926.22 – OSHA, Recording and Reporting of Injuries.

g. 29 CFR 1926.23 – OSHA First Aid and Medical Attention.

h. 29 CFR 1926.24 – OSHA, Fire Protection and Prevention.

i. 29 CFR 1926.25 – OSHA, Housekeeping.

j. 29 CFR 1926.26 – OSHA, Illumination.

k. 29 CFR 1926.27 – OSHA, Sanitation.

l. 29 CFR 1926.28 – OSHA, Personal Protective Equipment.

m. 29 CFR 1926.32 – OSHA, Definitions.

n. 29 CFR 1926.35 - OSHA, Employee Emergency Action Plans.

o. 29 CFR 1926.56 - OSHA, Illumination.

p. 29 CFR 1926.59 - OSHA, Hazard Communications.

q. 29 CFR 1926.95 – OSHA, Criteria for Personal Protective Equipment.

r. 29 CFR 1926.96 – OSHA, Occupational Foot Protection.

s. 29 CFR 1926.100 – OSHA, Head Protection.

t. 29 CFR 1926.101 – OSHA, Hearing Protection.

u. 29 CFR 1926.102 – OSHA, Eye and Face Protection.

v. 29 CFR 1926.103 – OSHA, Respiratory Protection.

w. 29 CFR 1926.104 – OSHA, Safety Belts, Lifelines, and Lanyards.

x. 29 CFR 1926.105 – OSHA, Safety Nets.

y. 29 CFR 1926.106 – OSHA, Working Over or Near Water.

z. 29 CFR 1926.107 – OSHA, Definitions Applicable to this Subpart.

aa. 29 CFR 1926.150 - OSHA, Fire Protection.

bb. 29 CFR 1926.151 – OSHA, Fire Prevention.

cc. 29 CFR 1926.152 – OSHA, Flammable and Combustible Liquids.

dd. 29 CFR 1926.153 – OSHA, Liquified Petroleum Gas.

ee. 29 CFR 1926.154 – OSHA, Temporary Heating Devices.

ff. 29 CFR 1926.153 – OSHA, Definitions Applicable to this Subpart.

gg. 29 CFR Part 1926 Subpart G OSHA, Signs, Signals and Barricades.

hh. 29 CFR Part 1926 Subpart K - OSHA, Electrical.

ii. 29 CFR 1926 Subpart L - OSHA, Scaffolding.

jj. 29 CFR 1926 Subpart X - OSHA, Stairways and Ladders.

kk. 40 CFR Part 61, Subparts A and M, U.S. Environmental Protection Agency (EPA), National Emission Standards for Hazardous Air Pollutants (NESHAP) - Asbestos.

ll. National Fire Protection Association (NFPA), Standard 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

mm. The American National Standard Institute (ANSI) Practices for Respiratory Protection ANSI 88.2-1980.

D. References in this Section to laws, codes, ordinances, regulations, standards or other Federal, state, municipal, local or departmental legal requirements shall be deemed to mean the latest version or revision thereof or successor thereto, notwithstanding any change in numbering, designation or titles in effect at the time of bid opening.

E. Unless specifically directed otherwise by the Engineer, the Authority will be the sole entity to monitor the project.

1.03 DEFINITIONS

A. Definitions and other terms used in this Section shall have the meanings set forth in 29 CFR 1910.1101; and for Work in New York State, as set forth in 12 NYCRR Part 56: Subpart 56-1.4, and for Work in New Jersey, as set forth in N.J.A.C. 5:23-8.2; and the following:

1. "Asbestos Abatement Permit Placard" shall mean a permit issued by the Port Authority authorizing the entity performing Work of this Section to commence with such Work

2. Authorized Person" shall mean a person provided by the Authority in accordance with U.S. EPA NESHAP, 40 CFR Part 61, Section 61.145 (c)(8).

3. "Certified Project Designer" shall mean a U.S. EPA Asbestos Hazardous Emergency Response Act (AHERA) Certified Project Designer for Work in New Jersey, or a New York State Department of Labor Certified Project Designer for Work in New York State.

4. "Emergency Exit" or "Egress" shall mean an area on the isolation barrier (i.e.: door or kick-out panel) that may be opened or broken for the immediate egress of people from the work area in case of an emergency.

5. "Initial Exposure Assessment", including "Negative Initial Exposure Assessment" are terms used in the OSHA construction standards. It means a required assessment by a "competent person" concerning the exposure potential of a specific asbestos job, or series of similar asbestos jobs. A "Negative Initial Exposure Assessment" is such an assessment in which it is concluded that employee exposures during the job are likely to be consistently below the Permissible Exposure Level (PEL). Assessments must be based on information and data which are allowed pursuant to criteria in OSHA Standard 1926.1101.

6. "Site Security/Fire Watch" shall mean an employee of the entity performing Work of the Section, who shall at a minimum possess the appropriate, valid state certification as an asbestos handler, who shall be on the "Work Site" at all times during periods of non-Work of this Section to ensure "Work Area" containment integrity, continuous operation of negative air filtration devices, security of the "Work Area" and security of asbestos waste stored at the "Work Site". In addition, when the operation of the existing fire protection system is impaired, deactivated, or compromised, the "Site Security/Fire Watch" person shall, in addition to being familiar with responsibilities of maintaining "Work Area" integrity, be familiar with the emergency response plans and procedures, and the use of the fire extinguisher provided at the "Work Site" for Work of this Section.

7. "Support Structures" shall mean any temporary structure constructed to reach, inspect, or perform Work of this Section.

8. "Work Area" shall mean the designated area within a "Work Site" where Work of this Section occurs which is isolated as required and to which access is restricted.

9. "Work Site" shall mean the construction site location(s) where Work of this Sectionis being performed.

1.04 QUALITY ASSURANCE

A. QUALIFICATIONS:

1. The entity performing Work of this Section shall be approved by the Authority prior to the commencement of Work of this Section and shall:

   a. Possess valid licenses, permits and certificates for the State in which the Work is to be performed.

   b. b. Employ for Work of this Section "Certified Project Designers", asbestos abatement handlers, restricted handlers, supervisors and air compressor operators who possess valid certifications and licenses for the State in which the Work is to be performed.

   c. Provide at the "Work Area" a "Competent Person" conforming to the requirements of 29 CFR 1926.32 (f), 1926.1101 (b), 40 CFR 61 Subpart M, and in addition, such person shall have at least three years of experience on asbestos abatement projects as an asbestos abatement supervisor in the State in which Work of this Section is being performed.

   d. Provide a Certified Industrial Hygienist (CIH) with at least three years of applicable experience in asbestos abatement, and with a certification by the American Board of Industrial Hygiene.

   e. Employ an environmental laboratory, approved by the Authority, that conforms to the Quality Control Procedures of 29 CFR 1926.1101 Appendix A, participates in a national sampling testing scheme such as the Proficiency Analytical Testing Program (PAT) or the Asbestos Registry sponsored by the American Industrial Hygiene Association.

   f. All subcontractors shall be approved by the Engineer or shall submit subcontractor(s) qualifications with the bid for all proposed Subcontractor(s). Any proposed subcontractor(s) performing work under this specification shall have appropriate qualifications. Subcontractor qualifications submitted shall be in such form and number as may be required by the Authority.

2. The asbestos waste transporter providing transportation services for Work of this Section shall be approved by the Authority prior to the commencement of Work of this Section, and hold the appropriate transporter permits, licenses and certifications for each State in which asbestos transportation is to take place. Such transporter shall transport asbestos-containing materials and/or asbestos-contaminated objects by licensed motor vehicle operators, in vehicles with valid motor vehicle registrations.

3. The landfill disposal site for the asbestos-containing materials and/or asbestos contaminated objects shall be a site or a facility with valid municipal, state, federal permits (where applicable) and approved by the Author ity prior to the commencement of Work at the "Work Area".

1.05 WORK AREA CONDITIONS

A. The Authority will perform the following air monitoring and analysis, and will provide analytical results of such air monitoring to the entity performing Work of this Section:

1. Baseline sample results collected within and adjacent to the "Work Area(s)" during normal occupancy conditions prior to the commencement of asbestos abatement activities.

2. Pre-abatement (area preparation) sample results collected within and adjacent to the "Work Areas" during asbestos abatement preparation activities (applicable to work performed in New York State only).

3. Sample results taken outside the "Work Area(s)" during abatement activities.

   a. If during the performance of abatement Work, area air sample results taken outside the "Work Area" exceed normal occupancy baseline levels or fiber concentrations in air at or in excess of 0.01 fibers per cubic centimeter (whichever is greater), the entity performing Work of this Section shall take the appropriate corrective action until acceptable levels are achieved, as determined solely by the Engineer.

4. Post-abatement air clearance results.

B. The Entity Performing Work of This Section Shall:

1. Perform initial employee exposure air monitoring in accordance with 29 CFR 1926.1101 (f)(2).

2. Perform full shift daily monitoring for a minimum of twenty (20%) percent of the workers performing a particular task within the "Work Area" each working shift in accordance with 29 CFR 1926.1101 (f)(3).

3. Throughout Work of this Section, the CIH, or the CIH's authorized representative, shall review and sign all air monitoring reports prior to the release of the data to the Contractor. Based upon employee exposure monitoring and analysis of airborne fiber concentration levels, the CIH shall determine the required level of respiratory protection established in accordance with 29 CFR 1926.1101(h).

   a. If based upon the results of employee exposure air monitoring the entity performing Work of this Section requests that monitoring be suspended in accordance with 29 CFR 1926.1101 (f)(4), the CIH shall determine if full shift monitoring accurately represented the airborne exposure to asbestos for the Work, and submit to the Engineer in writing for approval, a recommendation with reasons why monitoring may be suspended.

   b. Report results of employee exposure air monitoring analyses to the Engineer not more than twenty-four (24) hours after the collection of the sample, and post written laboratory results, signed by the CIH, or the CIH's authorized representative, in accordance with 3.01 E.3 herein within two (2) business days.

4. For post-abatement air clearance sampling provide, install, maintain and operate aggressive forced air equipment, e.g., fans, leaf blowers, in accordance with the requirements of the State in which Work is being performed.

5. Re-cleaning, if the "Work Area" fails the Post-abatement air clearance test on the first attempt, shall be performed by the entity performing Work of this Section at no additional cost to the Authority.

6. Ensure that the "Competent Person" stipulated in 1.04 A.1.c attend all meetings related to Work of this Section.

7. Perform Work in accordance with the Contract Documents.

C. Unless otherwise stipulated in Appendix "B" to this Section or as shown on the Contract Drawings, utilities and services, such as water, gas, sewers, electricity, steam heating / cooling ventilation, elevators, fire protection systems, sprinklers and smoke detectors, passing through the "Work Area(s)" shall continue service to areas outside of the "Work Area(s)". Where stipulated in Appendix "B" herein, or shown on the Contract Drawings shutdown and lock-out as necessary to perform Work of this Section. The Contractor shall provide that the entity performing Work of this Section shall coordinate with the Engineer prior to interrupting, re-routing or otherwise affecting any operating system, utility or service. The Authority will perform, and provide certification of utility and service shutdown(s), lockouts, and of required pressurization of ventilation duct systems. Notify the Engineer prior to the impairment or deactivation of the existing "Work Area(s)" and/or "Work Site" fire protection system.

1.06 SUBMITTALS

A. See Appendix "A"

Part 2. PRODUCTS

2.01 EQUIPMENT

A. Ensure that the entity performing Work of this Section provides, maintains, and/or uses the following equipment as required:

1. Respirators selected by the CIH based upon airborne fiber concentrations determined in accordance with 1.05 B. herein.

2. Daily employee exposure air monitoring equipment for not less than twenty percent (20%) of workers employed in each particular task per work shift in accordance with 1.05 B. herein.

3. Protective clothing and equipment for personnel exposed to airborne concentrations of asbestos fibers, including but not limited to whole body disposable covering, gloves, head covering, foot covering, hard-hats and eye protection.

4. The Contractor shall maintain stocked first aid kits in the clean room of the decontamination unit and in the work area including, but not limited to bandages, antiseptic wipes, burn cream, eye flushing solution, and tourniquet.

5. Dedicated respirators and personal protective clothing and equipment for the Engineer, and a maximum of three (3) for "Authorized Visitors".

6. Twenty-pound A-B-C multipurpose dry chemical fire extinguishers located in the clean and equipment rooms of the personnel and waste decontamination enclosure, emergency egress locations, and the "Work Area".

7. Negative pressure air filtration equipment.

8. Continuous chart recording manometers to measure differential air pressure.

9. Forced air equipment, e.g., leaf blowers and fans, for use during post-abatement air clearance sampling.

10. Fully enclosed and lockable waste dumpsters, trailers, or roll-offs, with the interior walls and floors lined with one (1) layer of 6-mil fire retardant polyethylene

11. Asbestos warning signs, leak-tight containers, and transportation labels conforming to 29 CFR 1926.1101(k), and 40 CFR Part 61, Section 61.1(a).

12. Spare containers and labels at the "Work Site", and on the waste transport vehicle for use in case of accidental loss or breakage.

13. HEPA vacuums, rubber or plastic dustpans, squeegees or non-metallic shovels with rounded edges, hand tools, OSHA approved ladders and scaffolds, and inclined chutes where required for Work at heights ten (10) feet or greater above the floor or adjacent ground surface.

14. When "Work Site" electricity is furnished from an existing electrical system, provide temporary electric and lighting from a panel outside of the "Work Area". Furnish and install a temporary electric panel equipped with ground fault circuit interrupters conforming to the National Electric Code for Work in New Jersey, and to the Electrical Code of the City of New York for Work in New York State. Temporary lighting level within the "Work Area" shall at a minimum conform to 29 CFR 1926.56, Illumination.

15. Battery operated emergency lighting within the "Work Area", personnel and waste decontamination enclosures, and emergency egress locations. Self-luminous emergency fire exit and directional signs identifying the path to, and location of, the personnel and waste decontamination enclosures, and emergency egress locations.

2.02 MATERIALS

A. *Ensure that the entity performing Work of this Section provides, maintains, and/or uses* the following materials as required for Work of this Section:

1. Leak-tight containment waste bags of clear or colored plastic, at least 6-mil in thickness with approved warning and transportation labels.

2. Commercially available glove bags of at least 6-mil transparent polyethylene with approved asbestos warning labels.

3. Surfactant, lock-down sealant, and encapsulating products which are recommended by the manufacturers for the specific type of asbestos being abated, and approved by the Engineer.

4. Lumber having a U.L. rating of FR-S. Lumber for temporary support structures shall be U.L. rated FR-S.

5. Minimum 6-mil polyethylene and reinforced polyethylene, with a fire retardant rating conforming to the requirements set forth by the NFPA Standard 701.

6. Other materials such as water-resistant duct tape, adhesives, caulking, nails, fasteners and hardware, as required to perform the Work of this Section.

Part 3. EXECUTION

3.01 PRE-ASBESTOS REMOVAL MEETING AND WORK SITE PREPARATION

A. Prior to the start of Work of this Section at the "Work Site", and after the submission and approval of the information required under 1.04 A and Appendix "A", the Engineer will schedule a pre-asbestos-removal meeting.

B. The following will be performed at the "Work Area" and "Work Site" by the Authority:

1. Post the U.S. EPA notification le tter, and if applicable, all re-notifications.

2. Post the Authority "Asbestos Abatement Permit Placard".

3. Post bulk sampling results.

4. As required, isolate, shutdown, pressurize, de-energize and lockout those utilities and services listed in applicable appendices herein.

5. Inspect and evaluate waste container(s) upon arrival at the "Work Site". Damaged, improperly sealing or locking waste container(s) shall be rejected.

6. Place locks on all waste containers.

7. *Field-verify the efficiency of the negative air units utilizing velometers and/or* manometers.

C. If Appendix "B" to this Section stipulates that a "Work Area" is a Confined Space as defined by *29 CFR 1926.21* and *29 CFR 1910.146*, the Contractor shall ensure that entity performing Work of this Section shall be responsible for and shall take the appropriate safety measures stipulated therein.

D. The Contractor shall ensure that the entity performing Work of this Section notifies the building occupants who may be impacted by Work of this Section with a letter, prepared by the Authority, a minimum of ten (10) days prior to the start of Work.

1. The Contractor shall ensure that entity performing Work of this Section posts the "Notice of Abatement Project" signs, provided by the Authority, ten (10) days prior to the start of Work; posted at locations determined by the Engineer.

E. Ensure that the entity performing Work of Section posts the following items on a notification board located at the entrance to the clean room of the personal decontamination enclosure:

1. A copy of the Abatement Contractor's State license.

2. Copies of the air-sampling technician's, project monitor's, supervisor's, handler's and restricted handler's State certificates.

3. OSHA air monitoring results (Within 48 hours of Sample Collection).

4. Emergency first aid procedures and notification telephone numbers.

5. If applicable, air compressor operator certificates of approval or fitness.

6. Name of the Work Site "Competent Person", and a list of names of workers who are authorized to enter the "Work Area(s)".

7. Chain-of-command and telephone numbers in accordance with Appendix "A" C.herein.

8. Copies of all required City and State asbestos transporter licenses, certificates, and permits.

9. Signs as required by 29 CFR 1926.1101(k) at all entrances to the "Work Area".

10. "No Smoking" signs.

11. A copy of this Specification Section and Appendices.

12. A copy of approved applicable, or project-specific, state variances pertinent to the project.

13. Laboratory results of environmental air samples as defined in Section 1.05 B.3.b.

F. The Contractor shall ensure that the following items shall be available at the "Work Area" and/or "Work Site" by the entity performing Work of this Section for inspection by the Authority or their duly appointed representative:

1. The Contract booklet and Contract Drawings and in addition, a copy of all approved submitted drawings and procedures.

2. Copies of applicable City, State and Federal regulations.

3. Material Safety Data Sheets.

4. NESHAP asbestos generator shipping labels.

5. The record of all manometer recordings.

3.02 WORK AREA PREPARATION

A. Work of this Section at the "Work Area" and/or "Work Site" shall not commence until all submittals are approved, and an "Asbestos Abatement Placard" has been issued by the Authority.

B. Work at the "Work Area" shall proceed only when the "Competent Person" and Authority "Authorized Person" are present at the "Work Area".

C. If the scheduled starting date cannot be met, the Contractor shall ensure that the entity performing Work of this Section requests a start date change in writing to the Engineer at least seventy-two (72) hours before the initial notice start date. Schedule changes are subject to the approval of the Engineer. Regulatory re-notifications shall be performed in accordance with 1.02 B.1 and B.2.

1. In the event of failure to commence with Work of this Section on the approved date without the consent of the Engineer to a start date change, the Contractor shall be responsible for the payment of all Authority administrative fees, including, but not limited to, preparation of and courier service for the hand delivery of the U.S. EPA re-notification letter.

D. Submit staging procedures and shift schedules. Notify the Engineer in writing of any shift changes not less than forty-eight (48) hours in advance. Such shift changes shall be subject to the approval of the Engineer.

E. The Contractor shall provide that the entity performing Work of this Section shall perform the following in accordance with Contract Drawings and Appendix "B" herein:

1. After utility shutdown in accordance with 1.05 C., remove filters from the HVAC system, double bag, store and dispose of as asbestos-contaminated waste. Seal all openings in the HVAC and other utility systems within the "Work Area(s)" with at least two (2) layers of 6-mil fire-retardant polyethylene sheeting.

2. Prior to the construction of the decontamination enclosure(s), remove asbestos that may be disturbed by such installation utilizing an approved isolation tent removal procedure to remove a one-foot wide strip at the locations where asbestos may be disturbed.

3. Pre-clean the location where the decontamination enclosure(s) will be constructed using HEPA vacuuming and/or wet cleaning in accordance with Appendix "B" herein.

4. Construct the decontamination enclosure(s) in accordance with the Contract Drawings, Appendix "B" herein, and/or approved Contractor submittals. Provide electric, water, and drainage to make the decontamination enclosure(s) and sanitary facility unit(s) operational.

5. Pre-clean the "Work Area" using HEPA vacuuming and/or wet cleaning methods.

6. Establish the "Isolation Barrier Partitions", "Critical Barriers", "Surface Barriers", or demarcate an area, and seal all openings. Stationary equipment within the "Work Area(s)" shall be enclosed, protected, and ventilated, as required in accordance with the Contract Drawings and/or applicable appendices herein.

7. Pre-clean fixed objects within the "Work Area(s)" and enclose objects to remain in accordance with the Contract Drawings and Appendix "B" herein. Pre-clean movable items before removal from the "Work Area" in accordance with the Contract Drawings and Appendix "B" herein.

8. Paint, or apply tape, in a fluorescent color at the fire extinguisher locations, door frames(s) of the personal and waste decontamination enclosures, emergency egress locations, kick-out panels and along wall bases showing direction towards the nearest exit.

9. Install and continuously operate the negative air filtration system in accordance with the Contract Drawings and/or applicable appendices herein.

10. Provide temporary lighting and power in accordance with 2.01 (A)(14) and Appendix "B" herein.

F. Notify the Engineer in writing that asbestos removal is ready to commence. No less than twenty-four (24) hours after such notification, a pre-removal inspection will be performed by the Engineer.

1. After a successful pre-removal inspection and approval of the Engineer, commence with asbestos removal.

3.03 ASBESTOS REMOVAL

A. The Contractor shall provide that the "Competent Person" employed by the entity performing Work of this Section performs the following:

1. Ensures that workers are equipped with respiratory protection and personnel protective equipment in accordance with Section 1.05 B.3.

2. Ensures that the negative air filtration system and manometers are maintained and continuously operated throughout "Work Area" preparation, asbestos removal, clean up, and post-abatement air clearance sampling in accordance with Appendix "B" and the Contract Drawings herein.

3. Ensures that the procedures of 29 CFR 1926.1101, Appendix "F" - "Wetting Agents" are complied with.

4. Ensures that "Site Security/Fire Watch" personnel to keep watch during non-work hours are utilized in accordance with Appendix "B" herein.

5. Ensures that prior to asbestos removal, all asbestos-containing materials are adequately wetted as regulated by the state in which the work occurs and as specified by the manufacturer.

6. Ensures that the removal of the asbestos-containing material is in accordance with Appendix "B" herein, and the Contractor's approved submittals.

7. Ensures that debris and water does not remain or pond on the floor and/or temporary "Support Structures". Adequately wet down, remove, and bag material while wet, concurrently during removal operations utilizing HEPA vacuums, rubber or plastic dustpans, squeegees or plastic shovels for continuous water and debris removal.

8. Ensures that disposal of waste water from the "Work Area" is performed in accordance with Appendix "B" herein.

9. Ensures that a permanently bound entry logbook for each "Work Area" is maintained and made available for the Engineer's inspection signed by all individuals who enter and leave the "Work Area(s)". The log shall identify the abatement contractor, the Authority contract and job number, and the respiratory protection used.

10. Ensures that the permanently bound daily log book for each "Work Area" is maintained with records of the Engineer's inspections and all findings, events, and required corrective action regarding, but not limited to daily inspections, integrity of the decontamination enclosure system(s), "Isolation Barrier Partitions ", "Critical Barriers", "Surface Barriers", the negative air filtration system, and all "Work Area" cleanings.

11. Unless directed by the Engineer to do otherwise, ensures that the condition of the waste container is examined by the "Site Security/Fire Watch" person (or "Competent Person" in the event that a Site Security/Fire Watch Person is not required) at least once every twenty-four (24) hours during non-work periods, and that repairs of torn or missing signs on the waste container, or damage affecting the integrity of the waste container are performed or that replacement containers are provided.

12. Ensures that for Work in New York State, the cleaning and surface lock-down encapsulation procedures in Subpart 56-12.1(i) of Industrial Code 56 are complied with.

13. Ensures that for Work in New Jersey, the cleaning and surface lock-down encapsulation procedure in 5:23-8.15(h) of the Asbestos Hazard Abatement Subcode is complied with.

14. Whenever possible, gross removal, packaging and cleaning shall proceed generally from the top downward.

15. Ensures that gross removal, packaging and cleaning shall proceed from locations which are remote from the HEPA units toward the areas of the units.

16. Ensures that wire brushes are not used for asbestos removal.

17. Ensures that compressed air and high-pressure water or steam are not used for asbestos removal.

3.04 DISPOSAL

A. Notify the Engineer in writing at least twenty-four (24) hours in advance of any bag out operations or waste container removal.

B. Remove asbestos waste from the "Work Site" only with the approval from the Engineer and an accompanying, properly signed Asbestos Waste Shipping Document issued by the Authority (Waste Shipment Record).

C. Transport the waste consignment to the landfill designated in the Contractor's approved submittals, U.S. EPA notification letter, and indicated on the Waste Shipment Record in accordance with 1.04 A.

D. The collection, co-mingling and transport of generated Authority asbestos waste with the asbestos waste from other generator sources is prohibited. Temporary storage or secondary transfer of the asbestos waste before final disposal is prohibited unless otherwise approved in writing by the Engineer prior to the waste leaving the "Work Site".

3.05 FINAL REPORT

A. This final report shall not be a substitute for the requirements of the Section of Division 1 entitled "Asbestos Cost Summary Submittal".

B. Final payment will not be approved prior to the Contractor preparing, itemizing and submitting to the Engineer four (4) copies of a final report containing:

1. A cover page identifying the entity performing Work of this Section with their phone number and business address, name of the "Competent Person", name and business address of the CIH and analytical laboratory, name and business address of the waste transporter, and name and business address of the landfill.

2. Summarize the type(s) of material removed, quantity of material removed, description of containment and engineering controls, amount of waste generated and date(s) transported from facility.

3. Daily project logs, entry logs, and if applicable, time and material sheets.

4. Analytical results of employee exposure air monitoring performed during Work of this Section, and strip or disk chart recordings of differential air pressure to areas adjacent to the "Work Area(s)".

5. Waste Shipment Record signed by the operator of the disposal site indicated in the Contractor's approved submittals.

6. Manometer recording logs. Manometer chart or tape shall include a date and time marker at least once per 24-hour period, and shall clearly indicate scale and zero.

7. The name, title and signature of the person preparing the final report.

END OF SECTION

SECTION 02081

ASBESTOS REMOVAL AND DISPOSAL FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY

APPENDIX "A"

SUBMITTALS

A. Prior to the "Asbestos Removal Meeting" the entity performing Work of this Section shall submit to the Engineer for approval the items listed below and any additional items requested by the Engineer.

B. Identify each set of submittals with the corresponding paragraph number for which the submittal is being presented.

C. Submit copies of the certifications, licenses and qualifications to perform Work of this Section as required in 1.04 A.1, 1.04 A.2 and 1.04 A.3 and all required project-specific items including, but not limited to, the following:

02081-01 Copy of valid Asbestos Contractor's License

02081-02 Information on Competent Person (i.e.: resume) showing:

02081-03 Three-years project supervision experience.

02081-04 Copy of valid Asbestos abatement Supervisor certificate.

02081-05 Asbestos Handlers certificates for the proposed staff.

02081-06 Information (i.e.: resume) on the "Certified Project Designer" the Contractor plans to utilize showing:

02081-07 Three-years asbestos project design experience.

02081-08 Copy of valid Asbestos Project Designer certificate.

02081-09 Information (i.e.: resume) on the Certified Industrial Hygienist (CIH) the

Contractor plans to utilize showing:

02081-10 Three-years asbestos related experience.

02081-11 Copy of valid American Board Industrial Hygiene certificate.

02081-12 Information on the Environmental Laboratory the Contractor plans to utilize, including:

02081-13 Proof of participation in the American Industrial Hygiene Association's Proficiency Analytical Testing Program [PAT].

02081-14 Outline of Respiratory Protection Program for Employees conforming with current regulations - The outline shall bear the signature and approval of a CIH.

02081-15 List of Subcontractors Contractor plans to utilize. Submit all their appropriate qualifications as per Section 02081, Part 1 (1.04)(A)(1)(a) and (f) herein.

02081-16 Name of Asbestos Waste Transporter Contractor plans to utilize -- the entity providing transportation services shall be approved by the Authority prior to the commencement of Work of this Section. Provide documentation showing, for each State in which transportation is to occur, the following:

02081-17 Copies of Transporter's Permits, Licenses and/or Certificates as required by state agencies to operate.

02081-18 Name and title of Transporter's contact person.

02081-19 Business, mobile and pager telephone numbers.

02081-20 U.S. DOT statement of reportable accidents and reportable environmental incidents as per 49 CFR 171.15 and 171.16

02081-21 Name of landfill Contractor plans to utilize. Contractor shall obtain approval from the Authority for utilization of proposed facility prior to commencement of Work of this Section [refer to Appendix "C" herein]; and submit the following documentation for the proposed facility:

02081-22 Municipal permits and/or licenses required to operate.

02081-23 State permits and/or licenses required to operate.

02081-24 Federal permits and/or licenses required to operate.

02081-25 Name, title and telephone number of Landfill's contact person.

02081-26 "Work Area" and "Work Site" procedures.

02081-27 Fire Prevention and First Aid Procedures.

02081-28 Work site communication with police, fire department, Facility Operations and the Engineer.

02081-29 Detailed site-specific Drawings prepared and signed by a "Certified Project Designer" which shall include, but not be limited to; the following:

02081-30 Negative Air Unit Calculations.

02081-31 Engineering Controls (i.e.: work area enclosure; decontamination enclosure system layout and location; work area boundaries; etc.).

02081-32 "Emergency Egress" location(s).

02081-33 Requirements for electric power, water supply and drainage.

02081-34 Requirements for storage and staging location(s).

02081-35 Project Specific Chain of Command -- Show on Chain of Command form(s) office, beeper, mobile and home telephone numbers of persons having the authority to dispatch personnel to the Project location and commit such persons to the tasks as directed by the Engineer. At a minimum include numbers for Project Supervisor, Competent Person and CIH.

02081-36 Support Structures – Drawings, design details and calculations for temporary "Support Structure(s)", signed and sealed by a Professional Engineer (P.E.) licensed in the State in which the Work of this Section is to be performed. Following installation of "Support Structure(s)", submit P.E. signed inspection report verifying compliance with design.

02081-37 List of all materials and equipment to be used.

02081-38 Catalog cuts for all materials and equipment to be used for Work of this Section, in accordance with the Section of Division 1 entitled "Shop Drawings, Catalog Cuts and Samples,"

02081-39 Material Safety Data Sheets and a copy of the product labels for all chemicals to be used for Work of this Section.

02081-40 A construction Critical Path Method (CPM) or Bar Graph Schedule stating critical dates of the job including start of mobilization, the preparation, removal, and reactivation of each work area, and completion of deactivation.

02081-41 A staffing schedule stating number of workers per shift, name and number of supervisor(s) per shift, hours per shift, shifts per day, and total days to be worked.

02081-42 Any changes in schedule or staffing shall be submitted in writing to the

Engineer 48 hours prior to implementation, or as directed by the Engineer.

02081-43 Copies of notifications and re-notifications, prior to sending, in accordance with Section 02081(1.02) (B) herein.

02081-44 Copies of the Final Report as stipulated in Section 02081(3.05) herein.

02081-45 Copies of project-specific variances obtained by the Contractor for Work of this Section.

D. The Contractor shall maintain records signed by a physician documenting worker medical examinations with chest X-rays and pulmonary function tests. The form from Appendix D of OSHA CFR 1926.1101 Title 29 or equal shall be used. These records shall be kept on file by the Contractor for the duration of employment, plus 30 years.

END OF APPENDIX "A"

SECTION 02081

ASBESTOS REMOVAL AND DISPOSAL FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY

APPENDIX "B"

JOB SPECIFIC REQUIREMENTS

A. Description

This Section specifies removal of asbestos material from the "Work Area(s)" (as shown on the Contract Drawings).

B. Asbestos Type(s)

Test results of asbestos-containing material to be removed indicate that such material contains the following type(s) of asbestos:

Area / Structure	Asbestos-Containing Material	Asbestos Type	Approximate % by Volume of Asbestos in Asbestos-Containing Material
Administration Building Roof	Black mastic & shingles	Chrysotile	3 - 5
	Tar paper (on roof flashing)	Chrysotile	15 – 25
	Grey Seam mastic (on roof)	Chrysotile	20 – 35
	Grey Caulk	Chrysotile	10 - 20
Toll Booths / Toll Islands	White / gray caulk	Anthophyllite	1.2 – 4.0
	Dark grey caulk	Chrysotile	2.2
	Black Insulation Paper	Chrysotile	10
	Black Felt Paper	Chrysotile	10
	White Transite™ Panels – Toll Booth #2	Chrysotile	7
Toll Plaza Tunnel	Pipe flange gaskets	Chrysotile	5.5 - 24
	Transite & insulation (including insulated wires)	Chrysotile (anticipated)	Unknown (suspected may be present in currently active electrical cabinets in the toll tunnel; or in Toll Booth #2)

C. Items in "Work Area" to be Removed

Remove the items shown on the Contract Drawings. Non-asbestos items in contact with asbestos-containing materials, such as caulks and mastics, and flashing materials, should likewise be removed from the "Work Site" as asbestos-contaminated items unless fully cleaned and shown not to be contaminated with asbestos.

D. Items Remaining in "Work Area" to be Protected

Protect these items:

- The Administration Roof (concrete roof) to be cleaned and protected during the abatement operations in a manner suitable for installing new roofing materials.

E. Utilities for Work of this Section

1. *Drainage:*

Drainage is not available at the "Work Site". Provide a closed piping or hose system and filter through 5.0 micron filters, drum collect and dispose of as stipulated in "Water Disposal Procedures" herein. In the event of asbestos contamination of temporary materials, clean and decontaminate by wet cleaning and/or HEPA vacuuming in the "Work Area" or dispose of as ACM waste.

In the event Work is required in New Jersey, drainage is not available at the "Work Site". All waste water generated at the "Work Area" or from the decontamination facility shall be collected and disposed of as stipulated in "Water Disposal Procedures" herein.

F. Utilities and Services in Work Area to be Shut Down and to Remain in Service

Electrical service to the toll booths and toll islands undergoing abatement should be shut-down prior to the start of the abatement; however, electrical service may continue to the other toll booths and toll islands. Coordinate with the Engineer.

G. "Work Site Security/Fire Watch"

Provide Security/Fire Watch as required under these specifications.

H. "Work Area" Procedures

I. *"Water Disposal" Procedures*

Prior to disposal of waste water, filter through a new three stage filter system where the final stage is a 5.0 micron filter to remove asbestos, and dispose of water away from Authority property in an appropriate sanitary sewage system. Do not re-use waste water.

In the event Work is required in New Jersey, prior to disposal of waste water, collect free water, add to asbestos-contaminated material and/or solidify with an approved polymer and dispose of as asbestos-contaminated material; or filter water through a new three stage filter

system where the final stage is a 5.0 micron filter to remove asbestos and dispose of in the sanitary drain, if allowed by local treatment works by regulation or as allowed by permit.

J. "Sealing Asbestos-Containing Contact Surfaces"

After removal, cleaning and final air clearance of the work areas, seal surfaces which were the subject of asbestos removal with a sealer approved by the Engineer and compatible with the replacement fireproofing and insulation. Also, seal end surfaces of asbestos-containing material that is to be enclosed and remain, if any, with a sealer approved by the Engineer.

K. Removal of "Work Area Containment and Protection of Items that Remained in the Work Area"

Remove "Work Area" containment and dispose of as asbestos contaminated material.

If the abatement area is to remain in operation, remove item wrapping and relocate and/or re-secure objects and items which were moved, wrapped and sealed and remained within the "Work area". Dispose of item wrapping as asbestos contaminated material.

Where the Work Area will be demolished, remove "Work Area" containment and discard as asbestos contaminated material.

L. *Re-establishment of Utilities and Services*

Where applicable under the Work, re-establish utilities and services that were disconnected and - if applicable - install new filters in air moving system(s) affected by the Work of this section. Otherwise, do not re-establish utility services or replace air moving system filters.

M. Re-establishment of Items and Objects in the Work Area

Unless otherwise directed by the Engineer, do not relocate items and objects that were cleaned and removed from the "Work Area" prior to commencement of abatement activities.

END OF APPENDIX "B"

SECTION 02081

ASBESTOS REMOVAL AND DISPOSAL FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY

APPENDIX "C"

Listed below are landfill disposal sites that are currently used, or have previously been used, by the Authority for the disposal of asbestos-containing material and/or asbestos contaminated objects. This list is provided for reference only and does not relieve the Contractor from verifying the facilities current valid state approvals or from submitting required documentation as outlined in Appendix "A". Furthermore, the Contractor is not limited to use of these disposal facilities:

WETZEL COUNTY SANITARY LANDFILL
New Martinsville, West Virginia 26155
304 455-3800

WASTE MANAGEMENT OF NEW YORK, Inc.
Varick Ave, Brooklyn, New York
617 271-9292

TULLYTOWN LANDFILL
(Tullytown Resource Recovery), Tullytown, Pennsylvania
215 736-9400

SUPERIOR GREEN TREE LANDFILL
Kersey, Pennsylvania
800 257-5705

SOUTHERN ALLEGHENIES LANDFILL
Conemaugh Twshp., Pennsylvania
814 479-2537

SOIL REMEDIATION INC.
Lowellville, Ohio

S&S LANDFILL
Route 5, Box 559
Clarkesburg, West Virginia 26155
304 745-3234

PENNSAUKEN SANITARY LANDFILL
Pennsauken, New Jersey

OTTAWA COUNTY LANDFILL
Port Clinton, Ohio 43452 (BFI Ohio)
419 635-2615

NEW MORGAN LANDFILL CO.,INC.
02081 - 24
New Morgan Borough, Exton Pennsylvania
610 286-6844

MINERVA ENTERPRISE INC
900 Minerva Road, Waynesburg, Ohio 46688

MEADOWFILL CORPORATION
Route 2, Box 68
Clarkesburg, West Virginia 26330
304753-9470

MAPLEWOOD RECYCLING & SANITARY LANDFILL
Route 640, Amelia County, Virginia
609 273-5818

M.C. ARNONI LANDFILL
Library, Pennsylvania

KELLY RUN LANDFILL
Elizabeth, Alleghany County, Pennsylvania
412 384-3133

IESI BLUE RIDGE LANDFILL
(Formerly R & A Bender Landfill,)
Greene Twnshp, Franklin County, Pennsylvania
717 264-4678

HAM SANITARY LANDFILL
1 Pozoo Road
Peterstown, West Virginia 24963
304-753-9470

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION BALER FACILITY
(Use this facility only for Work performed in Hudson County New Jersey)
100 Baler Boulevard
North Arlington, New Jersey 07031

G.R.O.W.S. LANDFILL, INC.
1000 New Ford Mill Road
Morrisville, Pennsylvania 19067
215-736-9400

GREENRIDGE RECLAMATION LANDFILL
East Huntington, Westmoreland County, Pennsylvania

GRAND CENTRAL LANDFILL
Painfield, Northampton County, Pennsylvania

CONESTOGA LANDFILL (BFI)
Exton, Berks County, Pennsylvania
610 286-6844

CENTRAL WASTE INC.
Smith Twnshp., Mahoning County, Ohio
330 823-6220

BROWNING FERRIS INDUSTRIES (BFI)
Fall River, Pennsylvania

110 CLEAN FILL DISPOSAL SITE
136 Spagnioli Road
Melville, New York 11704

END OF APPENDIX "C"

DIVISION 2

SECTION 02095

CONTAINMENT, WORKER, AND ENVIRONMENTAL PROTECTION

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for

1. The installation and use of containment systems for the removal of paint coatings containing lead and other toxic metals. All work on this project shall be performed in 1A containment as defined in the Society for Protective Coatings (SSPC) guidelines listed on the attached Table 1.
2. Worker and Environmental Compliance Plans for the protection of Contractor workers, the public, and the environment from exposure to harmful levels of dust, lead, and other toxic metals that may be present in the paint.
3. The protection of workers entering permit required confined spaces.
4. Ensuring that all waste is collected, handled, stored, transported, and disposed of in accordance with RCRA and other applicable regulations.
5. Complying with applicable noise regulations and criteria as specified herein, providing for noise mitigation and maintaining acceptable noise levels during construction.

1.02 REFERENCES

A. The following is a listing of the publications referenced in this Section.

Code of Federal Regulations (CFR)	
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926	Occupational Safety and Health Regulations for Construction
29 CFR 1926.20	General Safety and Health Provisions
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.51	Sanitation
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.62	Lead
29 CFR 1926.103	Respiratory Protection
29 CFR 1926.353	Ventilation and Protection in Welding, Cutting, and Heating
29 CFR 1926.400-417	Electrical Safety

29 CFR 1926.450-454	Scaffolding
29 CFR 1926.500-503	Fall Protection
29 CFR 1926.1118	Inorganic Arsenic
29 CFR 1926.1127	Cadmium
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 58	Ambient Air Quality Surveillance
40 CFR 60, App A-Method 9	Visual Determination of the Opacity of Emissions from Stationary Sources
40 CFR 60, App. A-Method 22	Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires
40 CFR 302	Designation, Reportable Quantities and Notification
40 CFR 204	Noise Control Regulations for Air Compressors
CFR 355	Emergency Planning and Notification
40 CRF 261, App. II	Toxicity Characteristic Leaching Procedure
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265, Subp. C	Preparedness and Prevention
40 CFR 265, Subp. D	Contingency Plan and Emergency Notification
40 CFR 265.16	Personnel Training
40 CFR 268	Land Disposal Restrictions
49 CFR 171-179	Hazardous Materials Transportation Act (HMTA)
	EPA Methods
Method 3050	Acid Digestion of Sediment, Sludge and Soils
EP/600/R-94/038b	Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II Ambient Air Specific Methods, Section 2.8 (Lead)
SW 846	Test Methods for Evaluating Solid Waste Physical/Chemical Methods
Method 1311	a.Toxicity Characteristic Leaching Procedure (TCLP)

NIOSH Methods

Method 7048	Cadmium
Method 7082	Lead
Method 7300	Chromium
Method 7900	Arsenic

The Society for Protective Coatings (SSPC)

Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
Guide 7	Guide for Disposal of Lead-Contaminated Surface Preparation Debris
SSPC 93-02	Industrial Lead Paint Removal Handbook, 2nd Edition, Volume I
SSPC 95-06	Project Design, Industrial Lead Paint Removal Handbook, Volume II

American Industrial Hygiene Association (AIHA)

	Environmental Lead Proficiency Analytical Testing Program (ELPAT)
	Environmental Lead Laboratory Accreditation Program (ELLAP)
	Proficiency Analytical Testing Program (PAT) for metals analysis
	Laboratory Accreditation for Metals Analysis
	American Board of Industrial Hygiene (ABIH) Certified Industrial Hygienist (CIH) Certification

American National Standard Institute (ANSI)

10.10	Safety requirements for temporary and portable space heating devices & equipment

New Jersey Administrative Code (NJAC)

NJAC, Title 7	New Jersey Pollution Prevention Program Rules
NJAC, Title 7	New Jersey Spill Control Regulations
NJAC, Title 7	New Jersey Surface Water Quality Standards
NJAC, Title 7	New Jersey Storm Water Management Rules
NJAC, Title 7	New Jersey Solid and Hazardous Waste Management Act
NJAC, Title 7, Chapter 26	New Jersey Air Pollution Control Laws
NJAC Title 7, Chapter 27	New Jersey Regulations on Toxic Substances
NJAC Title 7, Chapter 29 1.1 - 2.12	New Jersey Noise Control Regulations
NJAC, Title 8, Chapter 62	New Jersey Department of Health, Standards for Lead Certification
NJAC, Title 12, Chapter 120	Safety and Health Standards

NJAC, Title 13	New Jersey Solid Waste Management Act
NJAC, Title 58, Chapter 10 B	New Jersey Hazardous Discharge Site Remediation
NJAC, Title 58	New Jersey Water Pollution Control Act
NJAC, Title 5, Chapter 17	New Jersey Lead Hazard Evaluation and Abatement Code
	New York Code of Rules and Regulations (NYCRR)
Title 6, Chapter III, Part 211	General Process Emission Sources
Part 211.2	Air Pollution
Part 211.3	Visible Emissions
Title 6, Chapter III, 256-257	Ambient Air Quality Standards
Title 6, Chapter X	New York State Pollutant Discharge of Water Resources Elimination System
Title 6, Chapter 364	Waste Transporter Permits
Title 6, Chapter 370	Hazardous Waste Management
Title 6, Chapter 371	Identification and Listing of Hazardous Wastes
Title 6, Chapter 372	Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities
Title 6, Chapter 373	Treatment, Storage and Disposal Facilities
Title 6, Chapters 595-597	New York Rules of Releases, Registration, and Listing of Hazardous Substances
NYAC, Title 24, Chapter 2	Environmental Protection and Utilities Noise Control

1.03 REGULATORY REQUIREMENTS

A. Comply with 1.03 B. and 1.03 C. as though the Authority were a private corporation.

B. Comply with the requirements of this Section and all applicable federal, state, and city laws, codes, and regulations, including, but not limited to the regulations of the United States Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), New Jersey Department of Environmental Protection (NJDEP), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and the New York State Department of Labor (NYSDOL).

C. Comply with all applicable regulations even if the regulation is not specifically referenced herein. If a Federal, State, or City regulation is more restrictive than the requirements of this Section, follow the more restrictive requirements.

1.04 WORK AREA CONDITIONS

A. Throughout the Work of this Section, representatives of the EPA, NJDEP, NYSDEC, or other federal, state, or local agencies may be at the construction site and the Area of Work. Cooperate with and give assistance to such representatives as may be directed by the Engineer.

1.05 QUALIFICATIONS AND EXPERIENCE

A. Contractor and its Subcontractors

1. Verify that the Contractor or its subcontractor who will be performing the Lead Abatement Work in the State of New Jersey are certified under the Lead Hazard Evaluation and Abatement Code for Steel Structures and Commercial Buildings, at NJAC 5.17-2.1, and that the certifications are maintained throughout the duration of the Contract.

2. Provide evidence of at least 3 years of successful experience in the handling, storage, transportation, and disposal of hazardous waste from paint removal projects that are similar in size and scope to the Work under this Section. Submit a list of projects, a brief description of each, the date of completion, and the name, address, and telephone number of the Owner

B. Laboratory Qualifications

1. Verify that the analytical laboratory is American Industrial Hygiene Association (AIHA) accredited for metals analysis, and has successfully participated (previous 12 months at a minimum) in the AIHA ELPAT program and PAT program.

2. Confirm that the laboratory conducting the worker blood analyses is approved by OSHA and NYSDOH.

3. Verify that the analytical laboratory performing the waste characterization testing is certified by New York and New Jersey for such analyses.

C. Containment Design Engineer

1. Utilize Professional Engineer(s) who are licensed in the States of New York & New Jersey, to provide the ventilation and containment system design, shop drawings, and calculations for the loads and stresses imposed upon the containment system.

2. The Professional Engineer(s) must have not less than two years of structural engineering experience in the design of lead based paint removal containment systems, and must be certified as a lead Abatement Project Designer under NJAC 8:62.

D. Competent Person: Employ a competent person at the construction site who:

1. Has a minimum of two years industrial painting field experience, with a minimum of ninety days field supervisory or management experience in paint removal projects,

2. Holds valid certification of completion of 29 CFR 1926.62 (b) lead in construction training;

3. Has training in the relevant portions of 40 CFR 50 National Primary and Secondary Ambient Air Quality Standards (NASA), and New York site cleanup and spill response regulations;

4. Holds valid certification of Emergency response to Chemical incidents training in accordance with 29 CFR 1910.120 (q)(6)(i);

5. Holds a valid certification in Cardiopulmonary Resuscitation (CPR);

6. Holds valid certification as a competent person such as certificate for completion of The Society for Protective Coatings Supervisor/Competent Person for Deleading of Industrial Structures course or equivalent; and

7. Has been trained in hazardous waste management training in accordance with 40 CFR 265.16.(a), (b), and (c).

E. Certified Industrial Hygienist (CIH)

1. Confirm that the CIH holds a valid certification by the American Board of Industrial Hygiene (ABIH).

2. Verify that the CIH has at least two years experience on projects involving lead that are similar in size and complexity to the Work of this Section.

F. Workers/Supervisors

1. For work in New Jersey, confirm that at least one supervisor for each shift of operation is certified by the State of New Jersey Lead Abatement Supervisor Program for Commercial Buildings and Super Structures, and that the certifications are maintained throughout the duration of the Contract.

2. For work in New Jersey, confirm that all workers are certified by the State of New Jersey Lead Abatement Worker Program for Commercial Buildings and Super Structures, and that the certifications are maintained throughout the duration of the Contract.

3. Confirm that all workers and supervisors whose job description includes hazardous waste have been trained in hazardous waste management training in accordance with 40 CFR 265.16 (a), (b), and (c).

4. Confirm that all workers entering confined spaces have proper training in accordance with 29 CFR 1910.146.

1.06 SUBMITTALS

See Appendix A.

PART 2. PRODUCTS

2.01 CONTAINMENT MATERIALS

A. Supply all equipment and materials needed to contain debris in accordance with the attached Table 1 of this Section. This may include, but is not limited to, the following: ground covers, rigging, structural steel framing elements, decking, cables, planking, containment materials, dust collection and ventilation equipment, and HEPA vacuums.

B. Use materials that are free of loose dust and debris, both when brought onto the construction site, and upon removal.

C. Containment materials shall be fire retardant.

2.02 PERSONAL PROTECTIVE MATERIALS AND MONITORING EQUIPMENT

A. Monitoring and Testing Equipment

1. Supply the instrumentation needed for the monitoring of carbon monoxide, and worker and area exposures.

2. Supply equipment for the monitoring of weather conditions and wind velocity at the bridge. Provide Davis Weather Monitor II with an external temperature and humidity sensor, or equal. Davis Instruments, 3465 Diablo Avenue, Hayward, CA., 94545 (510-732-9229)

3. Supply 2 self-contained portable weather radios. Provide Maxon Co. Model WX-70 or equal. Maxon Systems, Inc., 10828 Northwest Air World Drive, Kansas City, Mo. 64153 (800-922-9083).

4. Provide all equipment to be used during confined space entry, whether permit required confined spaces or non-permit required confined spaces. Equipment includes, but is not limited to: lighting equipment, air monitoring equipment, ventilation equipment, personal protective equipment, and rescue equipment.

5. Supply all equipment needed for the operation of all instrumentation and monitors (e.g., generators, batteries, power cords, fuel, etc.)

6. Use equipment that is free of loose dust and debris when brought onto the construction site, and upon removal.

B. Personal Protective Equipment and Hygiene Facilities

1. Provide all personal protective clothing and equipment (PPE) needed for Contractor workers and for up to four Engineer representatives at each shift, including proper cleaning and disposal.

2. Repair or replace PPE as required to assure that it continues to provide its intended purpose.

3. Use PPE and hygiene facilities that are free of loose dust and debris when brought onto the construction site, and upon removal.

C. Waste Containers

1. Hazardous Waste - Provide DOT-approved containers of the appropriate size and type for the hazardous waste generated. Use containers that are resistant to rust and corrosion (painted, if constructed of steel), that have tight fitting lids or covers, and which are water-resistant and leak proof. Verify that the containers are acceptable to the disposal facility.

2. Municipal/Construction Waste - Provide all containers for non-hazardous municipal/construction waste. Use containers that are free of loose debris when brought to the construction site.

3. Spent Solvents - Provide all containers for spent solvents. Do not mix spent solvents with spent abrasives, paint debris, water, or other waste.

PART 3. EXECUTION

3.01 CONTAINMENT

A. General

1. Use a containment system that maintains the Work area free of emissions of dust and debris in accordance with all provisions of the Section.

2. All work shall be performed in 1A containment. Follow the containment requirements as specified in this Section and as stipulated in SSPC Guide 6 for the selected method of removal. The requirements are summarized in Table 1 attached to this Section.

3. The supervisor or foreman in the containment area must have a portable phone in his possession at all times when a containment is being installed, is in place, or is being dismantled in order to immediately receive information on upcoming inclement weather.

   a. In the event of impending inclement weather or when high winds cause excessive billowing of the containment or create a situation where contaminated dust and debris may be emitted from the containment system, suspend the paint or coating removal operations.

   b. When gusts or sustained winds are forecasted to be 40 mph or above, drop and secure the containment as stipulated later in this Section.

B. Containment Flooring System and Scaffolding and Additional Collectors

1. If the floor or ground beneath the structure being prepared serves as the base of the containment, cover it with air and dust impenetrable materials such as panels of plywood. Maintain the materials throughout the performance of the Work to avoid loss of debris through rips, tears, or breaks.

2. If a suspended or elevated platform is constructed to serve as the base of the containment, use rigid and/or flexible materials, and cover as needed to create an air and dust impenetrable enclosure.

3. Strictly follow all applicable OSHA regulations regarding the installation and daily inspection of scaffolding, platforms, and wire cables. Maintain a daily log of the results of the inspections made each shift, and after any occurrence which could affect the structural integrity of the scaffolding or wire ropes.

4. Provide ground covers around and beneath the Work Area to capture inadvertent spills or leaks of debris. Remove debris from the ground covers at least once per shift, or as directed by the Engineer.

C. Containment Components - The basic components that make up containment systems are defined below. The components are combined in Table 1 herein to establish the minimum containment system requirements for the method of paint removal specified for the Contract.

1. Rigidity of Containment Materials - Rigid containment material consists of solid panels of plywood, aluminum, rigid metals, plastic, fiberglass, composites, or similar materials. Flexible materials consist of screens, tarps, drapes, plastic sheeting, or similar materials. Do not use flexible materials for horizontal surfaces directly over traffic lanes or vertical surfaces in close proximity to traffic lanes.

2. Permeability of Containment Materials - The containment materials are identified as air impenetrable if they are impervious to dust or wind such as provided by rigid panels, coated solid tarps, or plastic sheeting. Air penetrable materials are those that are formed or woven to allow air flow. Water impermeable materials are those that are capable of containing and controlling water when wet methods of preparation are used. Chemical resistant materials are those that are resistant to chemical and solvent stripping solutions. Use fire retardant materials in all cases.

3. Support Structure - Rigid support structures consist of structural steel and framing (as shown conceptually on the Contract Drawings) to which the containment materials are affixed to minimize the movement of the containment. Flexible support structures are comprised of cable, chains, or similar systems to which the containment materials are affixed.

4. Containment Joints – Fully sealed joints require that mating surfaces between the containment materials and the structure being prepared are completely sealed. Sealing measures include tape, caulk, velcro, clamps, or other similar material capable of forming a continuous, impenetrable or impermeable seal. If emissions escape at the joints, a more positive means of sealing is required.

5. Entryway – An airlock entryway involves a minimum of one stage that is fully sealed to the containment and which is maintained under negative pressure using the ventilation system of the containment. Resealable door entryways involve the use of flexible or rigid doors capable of being repeatedly opened and resealed. Sealing methods include the use of zippers, velcro, clamps or similar fasteners. Overlapping door tarpaulin entryways consist of two or three overlapping door tarpaulins.

6. Mechanical Ventilation - The requirement for mechanical ventilation is to ensure that adequate air movement is achieved to reduce worker exposure to toxic metals to as low as feasible in accordance with OSHA regulations (e.g., 29 CFR 1926.62), and to enhance visibility. Design the system with proper exhaust ports or plenums, adequately sized ductwork, adequately sized discharge fans and air cleaning devices (dust collectors) and properly sized and distributed make-up air points.

7. Negative Pressure – Shall be required at all times to achieve a minimum of 0.03 in. (7.5 mm) water column (W.C.) relative to ambient conditions, or confirm through visual assessments for the concave appearance of the containment enclosure.

8. Exhaust Ventilation - When mechanical ventilation systems are used, provide filtration of the exhaust air. Use fabric filters designed for a 99.9% efficiency for particles greater or equal to 0.5 microns approximate equivalent diameter (AED).

D. Temporary Heating Units

1. 1.Use only self-contained, vented units, equipped with individual space thermostatic controls that have been tested and approved by UL, FM or another recognized association related to the type of fuel to be consumed.

2. Install and operate heating units in accordance with ANSI A10.10.

E. Work over Water and Coast Guard Requirements

1. When working over or near water, provide the necessary material and equipment at the construction site to contain inadvertent spills or releases of fuel, dust and debris. When working overland, provide a spill kit for any spills on land.

2. When the use of stationary water booms is not feasible or practical, use boats with skimmers to keep the water clean of debris, and have water booms available on shore for deployment in the event of a spill.

3. Remove all Work-related dust and debris from the surface areas at the end of each workday at a minimum. Include debris which is visible on the sediment along riverbanks, shorelines, and around piers.

F. Maintenance of Bridge Lighting Systems and Containment Lighting Requirements

1. Maintain all bridge and aviation lighting throughout the construction site. Aviation lighting must be visible and operational at all times while cleaning and painting the surrounding steel.

2. Comply with the Contract Drawings and Specifications for each individual Work Order addressing the removal, protection, and reinstallation of the bridge lighting, and for the use of temporary lighting.

3. Maintain all navigational and aviation lighting throughout the construction site. Provide the lighting plan to the Engineer for approval in advance.

4. Provide adequate lighting for all surface preparation, paint application, and inspection work. Maintain a minimum of 10 foot-candles for surface preparation and painting, and a minimum of 30 foot-candles of general area lighting for inspection. Increase the lighting if workers or inspectors have difficulty in seeing. Use explosion-proof lighting.

G. Relocation of Telephone, and Video Systems

1. Temporarily relocate, and assure the proper operation of telephones and video surveillance cameras that are present in the Work area. Reinstall the equipment in the original locations upon completion of paint application.

H. Protection of Drainage Systems and Fire Hoses

1. Protect storm sewers and drains from the entrance of debris from the performance of the Work. Keep all drain protection systems clean and operational throughout the duration of the Contract. At the end of each workday at a minimum, remove all visible debris from the drain protection systems, or from areas where rainwater could carry the debris into drains or storm sewers.

2. Identify the methods that will be used to route run-off from the existing deck drains through the containment enclosure. Do not close any bridge deck drains without the explicit approval of the Engineer.

3. Protect fire standpipes and hoses. Maintain immediate access to them at all times.

I. Cleaning and Securing of Containment at End of Work Day, Prior to Moving, and When the Containment will be Unmanned

1. At the end of work each day, or when the crew responsible for dropping and securing the containment leaves the containment area, remove loose abrasive and debris from within the containment to prevent emissions during non-working hours. Secure the containment and equipment as a safeguard against unanticipated heavy winds or inclement weather.

2. Prior to removing, dropping, or moving the containment, remove loose abrasive, debris, and dust to the extent that it is not dislodged by handling. Cleaning may be accomplished by blowing down all surfaces with the ventilation system in operation and/or by HEPA vacuuming.

J. High Wind Conditions and Inclement Weather

1. Monitoring of Weather Conditions

a. Provide 2 portable weather radios as specified in 2.02 A.3 and locate one in the Engineer's office and one in the Contractor's office trailer. Continuously monitor the NOAA weather radio broadcast on local weather conditions.

b. Contract with a FAX and phone weather service to anticipate high winds, inclement weather conditions, and weather emergencies in advance. The contract with the weather service shall provide continuous daily weather monitoring services for daily weather monitoring services without interruption for the duration of the Contract.

c. The weather monitoring service shall possess the following equipment and provide the following services:

(1) Dedicated 24/7 Access to the National Lightning Network.

(2) Satellite weather link-up receiver that obtains the following:

DIFAX/WEFAX circuit, FAA 4800 Baud circuit, FAA High Speed Circuit, Domestic and International circuit, Public Products Circuit, Numerical Products Circuit

(3) NEXRAD/DOPPLER Radar covering the construction site along with applicable WSR-57 and WSR-74 radar sites. Updated every 3 minutes.

(4) Satellite Link to GOES and NOAA satellites.

d. *The weather monitoring service shall provide forecasts for the following* seasonal weather phenomena:

(1) Winter: Snow and ice, severe cold, high winds, coastal flooding and dense fog

(2) Spring: Late season snow and ice, high winds, heavy thaws, heavy rains, dense fog, severe electrical storms and tornadoes

(3) Summer: Severe electrical storms, hail, high winds, heavy rains, tornadoes, dense fog and hurricanes

(4) Fall: Hurricanes, heavy rains, dense fog, early snow and ice storms

e. The weather monitoring service shall:

(1) Provide a detailed forecast tailored to the construction site when any storm is impending. Storm watches shall be posted 12 to 24 hours in advance and shall contain the following data:

(a.) Time storm is expected to begin

(b.) Type of precipitation

(c.) Predicted rate of and total accumulations

(d.) Time of changes and type

(e.) Expected duration of storm

(f.) Predicted wind speed

(2) During the course of major storms, provide hourly updated or revised bulletins for the construction site. Special forecasts of severe storms shall be included with as much lead time as possible. Forecasts shall detail which areas are expected to experience these conditions.

(3) During the hurricane season, furnish advisories and position reports of all tropical storms or hurricanes that may be of potential threat to the construction site. Furnish tracking charts if needed.

(4) Answer any questions 24 hours a day, 7 days a week regarding meteorological conditions in or forecast in the location of the construction site.

f. The weather monitoring service shall supply complete weather forecasting services 24 hours per day, 7 days per week. The weather forecast package shall consist of the following:

(1) Two forecasts faxed daily at 6:00AM and 2:00PM EST and shall include temperature, wind direction, wind speed, wind gusts, precipitation probability, type and amount, precipitation beginning and ending times, and visibility detailed for 12-hour periods for 48 hours.

(2) Updates containing watches, warnings or advisories shall be issued as needed depending on the current weather scenario.

(3) Forecasts shall be faxed to the field offices of the Engineer and the Contractor.

(4) Follow all faxed warnings with a phone call to the Contractor's 24-hour contact phone number for verbal communication of warnings.

(5) 24-Hour Storm Warning Service with updated forecast information issued every 1-3 hours or sooner during any storm situation, i.e., snow, ice, heavy rain, thunderstorms, strong winds, tornadoes, hurricanes etc.

g. Use the services provided by one of the following or approved equal:

(1) National Weather Service Forecast
175 Brookhaven Avenue, Bldg. No NWSI
Opton, NY 11973
(631) 924-0517

(2) Weatherdata Network
45-22 Little Neck Parkway
Little Neck, NY 11363
(718) 631-0808

h. Establish a continuous emergency phone and fax service with the weather company. Direct the company to immediately notify the Contractor in the case of sudden weather changes or if pending bad weather is approaching. When such notification is received, immediately contact the Engineer.

i. Submit to the Engineer on a daily basis, one copy of each FAX weather transmission containing the weather and wind velocity information used to decide whether or not the containment enclosure(s) should be lowered.

2. Definition of Inclement Weather and Required Action

a. Inclement weather which necessitates immediate action includes, but is not limited to, sustained wind speeds or gusts of 40 mph or greater, and heavy snow storms that will place unacceptable loads on the temporary structure.

b. Upon receipt of weather information of sustained wind speeds at 40 mph or greater, or heavy snow storms, immediately initiate the emergency demobilization plan approved by the Engineer to assure that all equipment is secure and that the necessary containment materials have been lowered or removed.

c. Follow the same emergency demobilization procedure if the Engineer directs the Contractor to dismantle the containment system based on the Engineer's determination of an excessive wind load condition.

K. Containment Monitoring During Shut Downs

1. Assign personnel to monitor the weather conditions during weekends, holidays, and other extended shut down periods. In the case of extended shut downs, inspect the containment, platform, and its components at least once every two weeks.

2. In the event of inclement weather, initiate the emergency demobilization procedure in the same manner as if the Work was in full operation.

3. During shut downs over the winter months, have a crew immediately available when needed at all times to remove snow from the containment system to avoid excessive loading, and to safeguard pedestrian and vehicular traffic.

L. Maintenance of the Weather Station
The Authority has installed a weather station on the New York side stair tower. Maintain the operation of the weather station throughout the duration of the Work.

3.02 NOISE ABATEMENT

A. The Authority will perform a survey of noise levels at and around the construction site to establish noise mitigation criteria, and will inform the Contractor of such criteria. At a minimum, if the median A-weighted L(eq)(10min) noise level measured at any residential receptor during construction activity is at any time 3 dB greater than the background noise level established without construction activity, then the impact of noise from construction shall be mitigated.

B. Any noise mitigation required for compliance with the established sound level criteria will be the responsibility of the Contractor throughout the Work of this Contract.

C. The Contractor shall submit a noise abatement plan to mitigate noise pollution generated from the Work, based on the noise mitigation criteria established herein.

D. The Contractor shall conduct sound pressure level tests in a professionally responsible manner to provide information required by the Authority. Measurements shall be supervised by an acoustician who is either a Board Certified Member of Noise Control Engineering or a Principal of a Member Firm of the National Council of Acoustical Consultants.

E. The Authority will measure noise levels emitted by Contractor's activity during the Work of this Contract to confirm that noise levels do not exceed the criteria established by the Authority. Any noise mitigation required for compliance with the established noise level criteria will be the responsibility of the Contractor throughout the Work of this Contract.

F. The Contractor will be advised when such monitoring will be performed and will be provided with verbal background and on-going results. Written results will be provided if requested by the Contractor.

G. Additional noise protection shall be provided on all noisy equipment and containments that are close to sensitive receptors (residences, stores, commercial businesses, etc..). Noise protection can be a combination of manufacturer recommended mufflers and, or flexible and solid noise barriers. Comply with the noise level criteria of 3.02 A.

3.03 WORKER PROTECTION CRITERIA FOR LEAD AND OTHER TOXIC METALS

A. Competent Person - confirm that daily inspections of all work areas will be made by a competent person.

B. Compliance Program - Maintain a copy of the Lead (Toxic Metal) Health and Safety Compliance Program at the construction site for review by all employees and interested parties.

C. Exposure Monitoring/Initial Assessment

1. Collect representative personal air samples at the beginning of the paint removal work to determine employee exposures to lead and other toxic metals that might be present in the coating. Tasks resulting in the potential exposure to toxic metals include, but are not limited to, paint removal activities, cleanup, and debris handling operations. Collect full shift (at least 7 hours) air samples for workers in each job classification in each exposure area.

2. When lead is present, protect workers during the initial monitoring to the anticipated exposure levels as dictated by 29 CFR 1926.62 and as specified below. A few activities in addition to those dictated by OSHA are included. Use the same level of protection when other toxic metals are found in the coating, unless OSHA has developed a comprehensive health and safety standard for that metal (e.g., cadmium and inorganic arsenic). In those cases, implement the protection requirements of the standard for that metal.

3. Assume an exposure of at least 500 μg/m3: Manual demolition of structures containing lead-containing coatings or paint (e.g., dry wall), manual scraping, manual sanding, heat gun applications, power tool cleaning with dust collection systems, and spray painting with lead paint. Although not identified in 29 CFR 1926.62, chemical stripping, water washing, and the operation of abrasive grit recovery equipment are included in this category.

   a. Assume an exposure of at least 2,500 μg/m3: Using lead-containing mortar, lead burning, or conducting the following activities where lead-containing coatings or paint are present: rivet busting, power tool cleaning without dust collection systems, cleanup activities where dry expendable abrasives are used, and the movement and removal of abrasive blasting enclosures. Although not identified in 29 CFR 1926.62, water jetting and wet abrasive blasting removal of paint are included in this category.

   b. Assume an exposure of more than 2,500 μg/m3: Activities involving lead containing coatings or paint on structures disturbed by abrasive blasting, welding, cutting, and torch burning.

   c. During any of the above activities, provide appropriate respiratory protection, personal protective clothing and equipment, change areas and washing facilities, blood lead and zinc protoporphyrin monitoring, and employee training. Maintain the protection as specified above until the test results are received, then modify the protection measures as necessary.

4. Collect and analyze all air samples according to the appropriate NIOSH method, or equivalent, for the metal of concern (e.g., Method 7082 for lead, Method 7048 for cadmium, Method 7300 for chromium, Method 7900 for inorganic arsenic).

5. Conduct periodic exposure monitoring of Contractor workers and provide written employee notifications within five days of receipt of results in strict accordance with the applicable OSHA standard for the metal of concern (e.g., 29 CFR 1926.62 for lead). At a minimum, this requires monitoring at the start of the Work, and after any changes in work practices are made which could have an effect on airborne exposures. If there is no OSHA standard for the detected metal, conduct the monitoring and employee notification based on the requirements of OSHA 29 CFR 1926.62. Provide the Engineer with the results of any subsequent monitoring within

the same 5 day notification period required for the employee, but no later than 10 days after sampling.

D. Action Level

1. The Action Level for lead is 30 $\mu g/m^3$ as an eight (8) hour Time Weighted Average (TWA), the Action Level for cadmium is 2.5 $\mu g/m^3$ as an 8 hour TWA, and the Action Level for inorganic arsenic is 5 $\mu g/m^3$ as an 8 hour TWA. For other metals that are found in the coating, and for which no Action Level exists, establish the Action Level at 1/2 of the Permissible Exposure Limit (PEL) (e.g., if the PEL is 5 $\mu g/m^3$, establish the Action Level at 2.5 $\mu g/m^3$).

2. In addition to the initial protection provided, invoke the following protective measures when the airborne exposure to a toxic metal found in the coating exceeds the Action Level:

   a. Exposure Monitoring

   b. Housekeeping

   c. Employee Medical Surveillance and Medical Removal Protection

   d. Employee Information and Training

   e. Signs and Restricted Zones

   f. Recordkeeping

E. Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV)

1. The PEL for airborne lead exposure is 50 µg/m3 as an 8 hour TWA. The PEL for cadmium is 5 µg/m3 as an 8 hour TWA, and for inorganic arsenic is 10 µg/m3 as an 8 hour TWA. The PELs or TLV's for other metals can be found in 29 CFR 1926.55.

2. In addition to complying with the requirements identified when exceeding the Action Level, invoke the following protective measures when the airborne exposure to a toxic metal found in the coating exceeds the PEL or TLV:

   a. Written Compliance Program

   b. Respiratory Protection

   c. Protective Clothing and Equipment

   d. Hygiene Facilities and Practices

F. Respiratory Protection

1. After feasible engineering controls and work practices have been implemented, use respiratory protection if necessary to maintain employees' exposures to lead and other toxic metals below the PEL or TLV. Require the use of respirators for all employees, inspectors, observers, or other personnel who enter areas where airborne exposures exceed or are expected to exceed the PEL or TLV, or when entering restricted zones.

2. Provide respiratory protection for up to four Engineer representatives at each site. The Engineer is responsible for verifying that the representatives are medically fit to wear respirators.

3. Develop a written Respiratory Protection Program in compliance with 29 CFR 1926.103, including commitments to provide the necessary medical examinations. When lead is present, include the provisions of 29 CFR 1926.62. When cadmium is present, include 29 CFR 1926.1127. When inorganic arsenic is present, include 29 CFR 1926.1118. Address the selection, use, maintenance and inspection of respirators, fit testing, and medical clearance for respirator users.

4. Treat used respirator cartridges as hazardous waste and dispose of in accordance with 3.09 hereinafter.

G. Protective Clothing and Equipment

1. Provide protective clothing and equipment and ensure they are worn by all employees whose exposures exceed the PEL or TLV. Provide all required protective clothing and equipment for use by up to four Engineer representatives at each site.

2. Do not allow workers to wear street clothing beneath protective clothing in any areas where exposures to toxic metals exceed the PEL or TLV.

3. Clean or replace the protective clothing as required by the appropriate OSHA standard for the toxic metal that is present. In the case of lead, clean or replace the clothing weekly if the airborne exposure levels are less than 200 μg/m3 as an 8 hour TWA, or daily if the exposure levels are greater than or equal to 200 μg/m3. In the case of inorganic arsenic, the threshold for daily versus weekly cleaning or replacement is 100 μg/m3. Do not use disposable clothing for a period longer than one day.

4. Do not remove or clean the clothing by any means which reintroduces the toxic metals into the ambient air such as brushing, shaking, or blowing. Use vacuums equipped with HEPA filters for cleaning.

5. Store the used clothing in sealed containers.

   a. If the clothing is to be laundered and it has been exposed to lead, label the containers with the following: "CAUTION: CLOTHING CONTAMINATED WITH LEAD. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, OR FEDERAL REGULATIONS." If the clothing has been exposed to cadmium, chromium, inorganic arsenic, or other metals, modify the above text accordingly.

   b. If the clothing is disposable, label the containers as clothing contaminated with lead and other toxic metals, if applicable. Apply hazardous waste labels as appropriate after testing.

6. If the clothing is washed on site, provide containers for the collection and retention of the water after filtration. Provide ample filtration (e.g., through a multi-stage filtration system ending in 5 microns or better if needed) until the water can be disposed of as non-hazardous. Conduct all required tests of the water, and comply with the provisions of this Section for its disposal.

H. Housekeeping

1. Clean accumulations of dust or debris containing lead or other toxic metals daily, at a minimum. Clean more frequently if visible accumulations are observed that could be carried outside of the restricted zone by wind, workers' shoes, rainwater, or other means.

2. Conduct all cleaning with HEPA vacuums. Do not use compressed air for housekeeping purposes unless it is used in conjunction with a ventilation system capable of capturing the resulting airborne particulate.

I. Personal Hygiene Facilities and Equipment/Decontamination Zone

1. Provide clean lavatory and hand washing facilities in accordance with OSHA sanitation standard 29 CFR 1926.51.

   a. Locate the hand washing facilities in close proximity to the paint removal operation, in an area that is convenient for washing prior to eating or smoking. Hot and cold water, hand soaps and towels shall be provided at the handwash facility.

   b. Provide showers when exposures exceed the PEL. Confirm that all employees whose exposures exceed the PEL or TLV shower prior to leaving the construction site. The Engineer's representatives will also use the lavatory and hand washing/shower facilities.

   c. If a remote shower facility is utilized, provide transportation for the exclusive use of the workers who are exposed to metals above the PEL or TLV. Clean the vehicles free of lead or toxic metals before leaving the construction site.

2. Filter and containerize all hygiene water. Provide ample filtration (e.g., through a multi-stage filtration system ending in 5 microns or better if needed) until the water can be disposed of as non-hazardous. Conduct all required tests of the water.

3. Prohibit eating, drinking, smoking, chewing of food or tobacco products, or the application of cosmetics in any area where the exposure to toxic metals exceeds the PELs or TLVs or within restricted zones, and confirm that workers thoroughly wash hands and face prior to undertaking any of these activities.

4. Provide clean lunch and break areas for use by all employees, and maintain airborne concentrations in these areas below the Action Levels.

5. Provide clean change area(s) for employees whose exposures exceed the PELs or TLVs. Equip the change area(s) with separate storage facilities for street clothing that are adequately segregated to prevent cross-contamination from work clothing. Assure that employees do not leave the construction site wearing any clothing that was worn while performing activities where exposures exceeded the PELs.

J. Medical Surveillance and Medical Removal Protection

1. Provide all employees with initial and periodic blood and zinc protoporphyrin (ZPP) sampling and analysis, and medical surveillance as required by the published OSHA health and safety standards for the metal of concern such as 1926.62 for lead and 1926.1127 for cadmium. Provide the specialized medical surveillance and X-rays required by 1926.1118 for employees exposed to inorganic arsenic. Provide cadmium blood and urine testing required by 1926.1127 for employees exposed to cadmium.

2. In the case of lead, conduct blood sampling and analysis prior to coming onto construction site and at a minimum of once every two months for the first six months of exposure, and at six month intervals thereafter. Conduct exit blood tests for each worker upon completion of his/her work activities which involve exposure to lead, even if this occurs prior to the completion of the Work of the Contract including seasonal suspension of Work.

3. Do not use workers with initial blood lead tests of 40 µg/dl for any work activities involving exposure to lead above the Action Level.

4. Provide for the temporary removal of employees from exposures above the Action Level for the metal of concern when the blood analysis indicates that unacceptable results are occurring (e.g., 50 µg/dl or above in the case of blood lead). Protect employees' benefits during any period of medical removal and conduct all tests required by the OSHA standard for the metal of concern during the removal period. In the case of lead, conduct blood sampling and analysis at a minimum of once every month during the removal period, and return workers to exposures above the PEL only after two consecutive blood tests are below 40 µg/dl.

5. Provide all physical examinations as required by the appropriate OSHA standards for the metal(s) of concern, and verify that all examinations are performed by or under the direct supervision of a licensed physician.

6. Provide all exam information and test results to the employees in writing within 5 days of receipt.

7. Provide the Engineer with letter reports signed by a CIH which summarizes all examination results, within 15 days of each testing period.

K. Employee Training and Information

1. Provide initial and annual refresher site-specific training for all employees who will be exposed to toxic metals above the respective Action Levels on any one day in a 12-month period. Include all of the elements of training that are required by the appropriate OSHA standard. If a standard for the metal does not exist, use the training requirements of 29 CFR 1926.62 as the basis of the training program highlighting the differences as appropriate for the other metals of concern.

2. When other contractors or employers are present at the construction site, notify them of the nature of the lead exposure work, the need to remain out of restricted areas, the warning signs and labeling system in effect, and the potential need for them to take measures to protect their employees in accordance with the applicable OSHA regulations.

L. Signs and Restricted Zones

1. As described later in this Section, establish restricted zones around areas or activities that might generate airborne emissions of toxic metals in excess of the Action Levels.

2. Post caution signs around each restricted zone. If there is no regulation for the metal of concern, use the legend for the CAUTION sign as found in 29 CFR 1926.62 as the basis, and insert the name(s) of the other toxic metals. Sign requirements for lead, *cadmium, and inorganic arsenic are as follows:*

WARNING
LEAD WORK AREA
POISON
NO EATING OR SMOKING

DANGER,
CADMIUM
CANCER HAZARD,
CAN CAUSE LUNG AND KIDNEY DISEASE,
AUTHORIZED PERSONNEL ONLY,
RESPIRATORS REQUIRED IN THIS AREA

DANGER
INORGANIC ARSENIC
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
NO SMOKING OR EATING
RESPIRATOR REQUIRED

3. Use signs that are a minimum of 8 1/2 inches by 11 inches in size with black block lettering on a white, yellow, or orange background. Do not use caution ribbons as a substitute for signs.

4. Verify that all workers who enter the restricted zone have had the proper training, blood analysis and medical examinations, and are wearing the required protective clothing and equipment. Prohibit eating, drinking, smoking, and chewing of food or tobacco products in any area where the exposures exceed the Action Level.

M. Recordkeeping

1. Retain all records related to training, medical examinations, blood analysis, exposure monitoring, respirator fit testing, inspections by a competent person, and other related documentation on file at the construction site and make available to the Engineer for review.

2. Retain all records for the duration of employment plus 30 years.

3.04 ESTABLISHMENT OF RESTRICTED ZONES

A. Identifying and Monitoring Restricted Zones

1. Establish restricted zones around locations or activities that might generate airborne emissions of lead, cadmium, chromium, inorganic arsenic, or other toxic metal in excess of the Action Level (e.g., paint removal and clean-up locations, dust collector staging areas, waste storage areas, etc.). Use ropes, ribbons, tape, or other visible means to define the areas and prohibit entrance into restricted zones by unprotected or untrained personnel to ensure that they are not exposed to toxic metals.

2. Conduct instrument monitoring to verify the adequacy of the restricted zone. Use a minimum of two low flow or two high flow pumps at each restricted zone location (e.g., one pump upwind and one pump downwind). Unless otherwise directed by the Engineer, until the monitoring results are available to establish the perimeter of the restricted zone, initially establish the boundary a minimum of 15 feet away from any equipment or operations that might generate airborne emissions of toxic metals.

3. Conduct the monitoring according to NIOSH Method 7082, or equivalent method for the other metals of concern, at the pre-established boundaries of the restricted zone(s). Collect the samples throughout an entire work shift upon commencement of the paint removal activities.

4. If the monitoring confirms that emissions at the established boundary do not exceed the Action Level as an 8 hour TWA, establish the boundary at that location and discontinue monitoring.

5. If the monitoring shows that the emissions exceed the Action Level, modify and improve work practices and containment to provide better controls over the emissions, or reestablish the boundary at a different location if allowed by the Engineer. Repeat the monitoring in either case.

6. Conduct additional monitoring to reconfirm the adequacy of the restricted zone at a minimum of once every two (2) weeks for the first three (3) months and at monthly intervals thereafter. If the restricted zone changes, establish the new boundary according to the monitoring procedures described in this Section.

7. Provide the test results to the Engineer in writing within one week of the field sampling.

B. Controlling and Reporting Access into Restricted Zones

1. Maintain a permanently bound daily entry log at each restricted zone. Identify the name of the Contractor and subcontractors on the log and the Authority Contract Number.

2. Have all individuals who enter the restricted zone sign in and out. Make the log available for Engineer's review.

3.05 ENVIRONMENTAL COMPLIANCE - VISIBLE EMISSIONS AND RELEASES TO AIR, SOIL, AND WATER

A. General - Conduct daily assessments of visible emissions and releases to the air, soil, water, and sediment, as applicable. Undertake all necessary corrective action to control emissions and clean up the work site during and after completion of the Work of the Contract, including the removal of pre-existing litter or debris.

B. Assessment and Correction of Visible Emissions

1. Conduct visible emissions assessments as defined in this Section and in accordance with 40 CFR 60, Appendix A, Method 22. Method PD/Lead A4 of SSPC publication 95-06, Project Design, provides guidance on visible emissions assessments.

2. Conduct the visible emissions assessments to account for all locations where emissions of lead dust might be generated, including but not limited to, the containment, dust collection and abrasive recovery equipment, and waste containerizing areas.

3. Conduct casual observations and corrections of visible emissions on an ongoing daily basis, but conduct the specialized assessments and inspections as described in this Section for a minimum of two, one-hour (continuous) intervals each shift.

4. No visible emissions are permitted to escape or pass beyond the restricted zones. Immediately stop the applicable operations if these criteria are violated. Correct and repair the deficiencies responsible for the emission, and undertake clean-up using HEPA vacuums.

5. Do not resume the emission-producing operations until the corrective action and repairs are inspected and approved by the Engineer.

6. Even if the visible emissions results are acceptable, immediately suspend the Work and initiate corrective action any time there are exceedances of high volume ambient air monitoring criteria conducted by the Engineer, in accordance with and as defined in Section 3.05.E.5.

C. *Assessment and Correction of Spills or Releases to Soil, Water, or Sediment*

1. Conduct all activities so that spills or releases of paint chips or debris to the soil, water, sediment, or storm sewers do not occur.

2. Visually inspect the construction site on an ongoing basis for releases of dust, paint chips, and debris outside of the work area that have become deposited on surrounding property, structures, equipment, or vehicles; on the unprotected ground, soil, water or sediment; around storm sewers or drains; or in areas where rain water could carry the debris into storm sewers or drains.

3. Clean up visible paint chips and debris on a daily basis at the end of each shift, or more frequently if directed by the Engineer. Clean up all paint chips and debris. Conduct the cleaning by manually removing paint chips or by using HEPA vacuums

4. When releases are observed, in addition to cleaning the debris, change work practices, modify the containment, or take other appropriate corrective action to prevent similar releases from occurring in the future. Do not resume operations until the corrective measures have been inspected and approved by the Engineer.

5. The Engineer will conduct laboratory testing and analysis of soil, water, and/or sediment to determine if they have been impacted by the Work. Sampling shall also be conducted at the hazardous waste storage areas prior to the start of Work. The Contractor will be advised when such testing and analysis will be performed. Sample site selection will be conducted by the Engineer and sample removal will be in accordance with the guidance provided in Methods S1 and WS1 of SSPC publication 95-06, Project Design. The ground (soil), water, and sediment will be considered to have been impacted by the Work based on the laboratory analysis as described below:

   a. Visible paint chips or debris on the ground, water, or sediment are not allowed and must be removed regardless of the laboratory test results.

   b. Soil - The ground (soil) is considered to have been impacted by the Work based on increases over the geometric mean lead concentration existing at the start of the Work.

      (1) If the geometric mean total lead concentration existing at the start of the Work is less than 200 ppm, an impact is considered to have occurred if the geometric mean lead concentration shows an increase of 100 ppm or more.

      (2) If the concentration existing at the start of the Work is greater than 200 ppm, an impact is considered to have occurred if the geometric mean lead concentration exceeds the initial geometric mean plus 2 standard deviations, or an increase of 100 ppm occurs, whichever is greater.

   c. Sediment- The sediment will be considered to have been impacted from the Work following the same criteria utilized for soils.

   d. Water - The water is considered to have been impacted by the Work based on increases over the geometric mean lead concentration existing at the start of the Work.

      (1) If the geometric mean total lead concentration existing at the start of the Work is less than 3.5 μg/L, an impact is considered to have occurred if the geometric mean lead concentration shows an increase of 1.5 μg/L or more.

      (2) If the concentration existing at the start of the Work is greater than 3.5 μg/L, an impact is considered to have occurred if the geometric mean lead concentration exceeds the initial geometric mean plus 2 standard deviations, or an increase of 1.5 μg/L occurs, whichever is greater.

6. If the laboratory analysis shows the soil, water or sediment to have been impacted by the Work, as directed by the Engineer, conduct the cleanup or remediation necessary to return the media to pre-existing levels, at no additional cost to the Authority.

D. Reporting of Visible Emissions and Releases

1. Maintain and make available for the Engineer's inspection, a permanently bound daily log documenting inspections and the occurrence of unusual incidents, if any, at each Work Area(s).

2. Document in the log, all cases where work has been halted due to unacceptable visible emissions or releases, the cleanup activities invoked, and the corrective action taken to avoid a recurrence. Provide a written report to the Engineer within 48 hours of the occurrence.

3. Summarize the results of the assessments in a monthly report. Identify the frequency of observations made, the methods of observation utilized, the name of the observer(s), and results. Include and summarize the documentation prepared for work stoppages due to unacceptable visible emissions or releases. Provide monthly reports to the Engineer within 15 days of the last workday of the previous month.

E. High Volume Ambient Air Monitoring

1. The Engineer will undertake high volume ambient air monitoring during paint removal and clean-up activities to confirm that emissions do not exceed the EPA National Primary and Secondary Ambient Air Quality Standards (NAAQS), or specific New York City or New Jersey regulations.

2. Total suspended particulate (TSP-lead) will be analyzed in accordance with 40 CFR 50 Appendix G.

3. The number and location of monitors will be determined by the Engineer, taking into consideration proximity to homes, businesses, and the general surroundings. Monitor siting and operation will be performed in accordance with the guidance provided in Methods A1 and A2 of SSPC publication 95-06, Project Design.

4. The Contractor will be advised if such monitoring will be performed and will be provided with verbal background and ongoing results. Written results will be provided if requested by the Contractor.

5. Take the following corrective action when air monitoring results exceed the following:

   a. If the emissions of 1 day of blasting exceed:

      (1) 0.45 $\mu g/m^3$ (8 hour period) minus two times the average 8 hour background level for TSP-lead,

      (2) Assess all field data for that day and take appropriate corrective action to control emissions.

   b. If the emissions of 2 consecutive days of blasting exceed:

      (1) 0.45 $\mu g/m^3$ (8 hour period) minus two times the average 8 hour background level for TSP-lead,

      (2) Suspend dust producing operations (e.g., paint removal and/or clean-up) and implement appropriate corrective action to control emissions.

   c. If the emissions on any one day exceed:

(1) 1.35 μg/m3 (8 hour period) minus two times the average 8 hour background level for TSP-lead,

(2) Suspend dust producing operations (e.g., paint removal and/or clean-up) and implement appropriate corrective action to control emissions.

3.06 CLEANING OF MATERIALS, EQUIPMENT, AND SURROUNDING PROPERTY

A. Equipment and Material Cleaning Requirements

1. Remove debris from the containment materials and equipment prior to relocation to another point along the structure or within the facility. Clean to the extent that debris or dust are not dislodged by winds or physical contact during handling and transportation. Use compressed air for cleaning only if it is accomplished inside a contained area that is equipped with an operating ventilation system capable of capturing the dust and debris.

2. Thoroughly HEPA vacuum, wash, or otherwise decontaminate reusable items until all loose surface dust and debris have been removed. Items requiring cleaning include, but are not limited to, paint removal and ventilation equipment, containment materials, ground covers, and scaffolding.

3. If adequate cleaning is not possible, treat the materials as a separate waste stream, and dispose of in accordance with the requirements of 3.08 herein. Collect water used for cleaning and dispose of in accordance with the requirements of 3.08 herein.

4. When the Contractor uses solvents to clean painting equipment, treat the spent solvents as a separate waste stream. Collect the spent solvents, perform the sampling, testing, and classification, transportation, and disposal of the solvent waste stream in accordance with 3.08 herein.

B. Final Cleaning/Clearance Evaluations of Construction Site and Surrounding Property

1. Upon completion of all Work, and after all Contractor equipment and materials have been removed, conduct a thorough inspection of the construction site, and all surrounding property and surfaces located within the likely dispersion zone of dust and debris for the presence of debris. Debris includes, but is not limited to, spent abrasives or other paint removal media, paint chips, materials of construction, fuel, and other litter.

2. Remove all visible debris from the construction site. When cleaning paint chips and dust, use HEPA vacuums, manual removal of paint chips and debris, wet washing, or other means that will effectively remove the dust and debris without re-dispersing it into the air. Do not use compressed air for cleanup activities unless it is used in conjunction with a ventilation system designed to capture the airborne particulate

3. Collect water used for cleaning and dispose of in accordance with 3.09 herein

4. After all clean up activities are completed, conduct a final inspection with the Engineer. Conduct any additional cleaning identified by the Engineer. Consider the construction site properly cleaned under the following conditions:

   a. Paint chips, spent abrasive and other paint removal media, fuel, materials of construction, litter, or other debris are not visible on or around the construction site.

b. Lead dust has been removed from the surface of the completed structure as well as from surrounding structures and equipment.

5. Collect solvents used for painting equipment cleaning and any spent solvents, and dispose of in accordance with 3.09 herein.

C. Report on Clearance Inspections

1. Prepare a letter report presenting the results of the inspections conducted to verify the final cleanliness of the construction site, surrounding property, waterways, equipment, buildings, and structures.

2. Include a summary of any problems or releases that occurred during the performance of the work, and the clean up and corrective action measures that were taken to resolve the problem.

3. Provide final clearance report within 10 days of final inspection.

3.07 REPORTABLE RELEASES

A. A release of material in a 24 hour period of ten pounds or more of lead is a reportable quantity under the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA).

B. Immediately shut down operations following any emergency situation or accident or non-compliance incident, estimate the quantity of lead released into the environment, and undertake clean-up.

C. If there is a release of ten or more pounds of lead in a 24 hour period from the construction site, immediately notify the Engineer, NYSDEC or NJDEP as applicable, and the National Response Center at 800-424-8802 in accordance with 40 CFR 302.6. Within 2 days of the incident, provide the Engineer with a written report of the cause of the problem, the estimated quantity of lead released, and corrective action taken to prevent a recurrence

3.08 ON-SITE MANAGEMENT, TRANSPORTATION, AND DISPOSAL OF PAINT DEBRIS, WASTE WATER, AND ANY OTHER WASTE GENERATED FROM THE WORK

A. GENERAL

1. The Authority and the Contractor are responsible for the hazardous waste generated from this Work. All waste products shall be handled, transported, stored and disposed in accordance with RCRA and other applicable federal, state and local requirements. The Authority will provide the EPA identification number for lead waste disposal for permitting purposes, but the Contractor is responsible for the collection, handling, storage, transportation and disposal of all wastes. The Contractor is responsible for payment of any fees or taxes (e.g. including annual or quarterly fees, per load stipends, etc.) imposed by any state or local taxing agency for hazardous waste disposal.

2. The Contractor is responsible for the collection, handling, transportation, and disposal of all solvent wastes generated from the Work. The Contractor must acquire his own EPA identification number for the disposal of solvent wastes.

3. The Contractor is responsible for the collection, handling, transportation, and disposal of all non-hazardous municipal/ construction waste and waste water generated from
the Work.

4. The Contractor is responsible for recovering all waste products generated during the paint removal Work, including but not limited to rags, tape, disposable coveralls, filters, and sediments. These materials should be characterized to determine if they are hazardous wastes in accordance with RCRA and applicable New York and New Jersey requirements.

5. Store waste only at location designated by the Engineer. Transport the waste to the designated storage area at the end of each working day, at a minimum. Satellite accumulation areas must meet all RCRA requirements, such as volume limits, container limits and labeling.

6. Store paint, solvent or paint and solvent wastes on Authority property and in accordance with applicable regulations.

7. Hazardous waste manifests and fees imposed by the States shall be handled and paid for by the Contractor. The Contractor will be reimbursed by the Authority.

B. WASTE SAMPLING, TESTING, AND CLASSIFICATION (SOLID WASTE AND WASTE WATER)

1. Sampling

a. Solid Waste (with the exception of waste water)

(1) Engineer shall collect and have analyzed, representative samples of each waste stream generated by the Work.

(a.) Collect the samples with assistance of Contractor, as needed..

(b.) Collect the samples in accordance with SW-846, "Test Methods for Evaluating Solid Waste -Physical/Chemical Methods." Use a random sampling technique.

(c.) Collect a minimum of four representative samples of all waste streams. These waste streams include, but are not limited to, spent abrasives, paint chips and dusts, spent solvents, solvents used for paint thinning and equipment cleaning, dust collector debris and chemical stripping
debris.

(2) Complete the initial sampling of each waste stream immediately upon contractor filling the first container, or within 30 days of the beginning of waste accumulation. After the representative samples are collected, the Engineer shall send them immediately to the laboratory for analysis.

(3) Unless otherwise directed by the Engineer, or required by State regulations or the waste recycling or disposal facility, once each waste stream is sampled, tested, and classified, additional sampling and analysis are not required for subsequent shipments unless the waste stream changes.

b. Waste water

(1) Engineer shall collect representative samples of waste water generated by the Work.

(2) Engineer shall complete the initial sampling of each waste water stream immediately upon filling the first container, but shall not allow waste water to accumulate for longer than 30 days before sampling. After the representative samples are collected, send them immediately to the laboratory for analysis.

c. Sampling Frequency

(1) If the nature of the waste stream initially tested remains constant (e.g. the paint system remains the same), additional testing and analysis are not required for subsequent shipments unless otherwise directed by the Engineer, or required by state regulations or the disposal facility.

(2) If the nature of the waste stream changes after the initial testing, Engineer shall collect and have analyzed a new series of samples of the waste stream.

(3) *If there is a Work shut down at the end of a season (e.g. winter shutdown),* Engineer shall collect and have analyzed a new series of samples (i.e. a minimum of four representative samples) of each waste stream when the Work resumes.

2. Testing

a. Solid Waste – Engineer shall

(1) Direct the laboratory to test the solid waste in accordance with 40 CFR 261, Appendix II, Method 1311, Toxicity Characteristic Leaching Procedure (TCLP), to determine if it is hazardous.

(2) Analyze the first two samples from each waste stream for full TCLP as defined in C.3.a)(1)(a) hereunder. Conduct any additional test required by the disposal facility. Analyze subsequent samples of the waste stream(s) for lead and any
metal or hazardous material that is detected in the initial TCLP testing. *When chemical strippers are used, test all liquids and sludge. Include pH to* determine corrosivity. Test all
spent solvents, and solvent/sludge resulting from paint equipment cleaning.

(3) Waste water - test the waste water for Total metals (As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Zn), hexavalent chromium, pH, suspended solids, oil and grease, BOD, temperature, total cyanide, TPH, and other analytical parameters required for disposal characterization or by the disposal facility.

3. Classification of Solid Waste

a. Hazardous Waste Classification

(1) A waste stream shall be classified by Engineer as hazardous waste if it meets any of the following criteria:

(a.) It is a RCRA listed hazardous waste as defined in 40 CFR 261, Subpart D (i.e. many solvent and paint wastes are RCRA listed wastes).

OR

(b.) The leachate contains any of the 8 metals or other hazardous substances in concentrations at or above limits established in 40 CFR 261.24 including but not limited to:

Arsenic	5.0 mg/L
Barium	100.0 mg/L
Cadmium	1.0 mg/L
Chromium	5.0 mg/L
Lead	5.0 mg/L
Mercury	0.2 mg/L
Selenium	1.0 mg/L
Silver	5.0 mg/L
Methyl Ethyl Ketone	200 mg/L

OR

(c.) The waste has the following RCRA characteristics, as defined in 40 CFR 261, Subpart C :

Corrosivity

Ignitability

Reactivity

OR

(d.) The waste stream contains total PCBs at or above 50 mg/L.

b. Non-hazardous waste classification

(1) Waste streams shall be classified by Engineer as non-hazardous if:

(a.) It is not a RCRA listed hazardous waste and

(b.) The waste contains toxic metals or hazardous substances below or outside of the threshold identified above which would classify it as hazardous.

(2) When paint debris TCLP test results indicate lead concentrations less than 5 mg/L, notify the disposal facility that the waste contains lead and provide the TCLP test results.

c. Classification of waste generated using steel abrasive: When recycled steel grit abrasives are used and the resulting TCLP test results indicate lead concentrations from 1 to less than 5mg/L, Engineer shall notify the Contractor and Treatment Storage Disposal (TSD) facility that the waste contains lead. Provide the TCLP test results, and stipulate that further stabilization to TCLP levels below 0.75 mg/L is required prior to disposal.

d. Painted Scrap Metal

(1) Painted scrap metal that is disposed of or recycled is a solid waste; however, it is exempt from EPA Subtitle C regulation when it is reclaimed.

(a.) Scrap steel coated with paint, which contains lead or other heavy metal, can be shipped for recycling. If not shipped for recycling, the Engineer shall direct the Contractor to handle, test, store and dispose of it in the same manner as paint removal waste, as detailed in preceding sections.

(b.) The Contractor shall store all demolition metal on solid ground covers or on solid surfaces, such as pavement and isolate the area with ribbons or other barriers. The storage area need not be covered unless loose paint is present which rain or wind could dislodge.

(c.) An MSDS or letter shall accompany scrap metal shipments identifying the heavy metals present. A copy of MSDS or letter shall be provided by Contractor to Engineer.

(d.) The Contractor shall obtain written confirmation from the scrap dealer at the time the scrap metal is received, stating that the painted metal will be re-melted and properly destroyed.

4. Laboratory Report

a. Shall include the following minimum information in each report: Identity of the RCRA listed waste streams and identity of the waste stream(s) analyzed, the number of samples collected and tested, dates of sampling and testing, laboratory test procedures utilized, the names and signatures of the individuals collecting the samples and analyzing the laboratory tests, interpretation of the test results, and final determination.

b. Include copies of the chain-of-custody forms in the documentation of hazardous waste and non-hazardous waste streams.

c. Provide laboratory reports to the Contractor within 15 days of sample collection but no later than 45 days after start of Work.

C. WASTE HANDLING, PACKAGING, AND STORAGE

1. Contractor shall under supervision of PA facility environmental coordinator comply with 40 CFR 262, NJAC Title 7, and 6 NYCRR 372 for the on-site handling, packaging, and storage of all waste generated by the Work.

2. All paint debris shall be vacuumed and collected in DOT-approved drums or containers in compliance with 49 CFR 173 and 178 at the end of each Work period. Paint debris shall include paint chips and dust and shall not include any other construction debris, trash or chemical solvents. All disposable protective clothing and interior lining of the containment system shall be collected in DOT-approved drums or containers at the end of each Work period.

3. Contractor shall not place hazardous waste on unprotected grounds (e.g. cover the ground with impervious tarping). Locate in a secure area with signs around the perimeter, and shield adequately to prevent dispersion of the waste by wind or water.

4. At a minimum, Contractor shall collect and store the hazardous waste at the end of each working day in storage drums or containers such that no waste is left overnight. Use DOT-approved drums for hazardous waste storage. Once a drum of hazardous waste at the Work areas is full, move it to a designated secure storage area within 3 days. The hazardous waste generated from Work in New Jersey shall be stored in New Jersey. The hazardous waste generated from Work in New York shall be stored in New York.

5. Contractor shall properly transport all non-hazardous waste municipal/construction waste from the Work areas to the designated storage area. Verify that the waste is completely covered during transportation.

6. Contractor shall maintain all drums and containers in good operating conditions with all lids and closing mechanisms intact and operational to prevent escape of debris by winds, spilling of contents, or access by unauthorized personnel.

7. Contractor shall cover all drums immediately upon filling and confirm that all lids are attached except when filling. Verify that all drums are labeled upon filling and that labels remain intact.

8. Contractor shall inspect the drums or containers for corrosion and leaks. Conduct daily inspections in New Jersey, and weekly inspections in New York. Record the results of the inspections in a log book and make available to the Engineer for review.

9. Contractor shall store non-hazardous waste separately from hazardous waste. Do not co-mix hazardous waste with non-hazardous waste. Do not mix different types of hazardous waste unless specifically approved by the Engineer.

10. Contractor shall arrange containers in the storage areas for easy accessibility. Stage the containers together in lots no greater than two rows of five containers each. Maintain a minimum lane clearance of 36 inches between each lot of ten containers.

11. Contractor shall verify that all waste is transported to the appropriate recycling or disposal facility within 60 days after waste is first placed into the container.

12. Improper waste storage is cause for immediate suspension of the Work by the Engineer until appropriate corrective action is completed.

13. Contractor shall train all personnel in the proper handling of hazardous waste at the Work site in accordance with 40 CFR 265.16, including the procedures to follow in the event of a release or spill, required notifications, and methods of clean-up. Maintain all training records on-site and make available to the Engineer for review.

14. Contractor shall not fill any drums in excess of the capacity marked on the container.

15. If soil remediation is required as a result of Contractor activities, Contractor shall place the soil into separate containers, and assume all costs for its disposal.

D. LABELING OF CONTAINERS

1. Contractor shall immediately label all containers of waste and paint debris to identify the contents. Label containers of paint debris as HAZADOUS WASTESCONTAINING LEAD CHIPS. Include the Contract Number and locations. Provide similar labels on containers of other waste, wastewater and debris.

2. After the TCLP test results are received, or after determination of hazardous waste status based on generator knowledge of waste stream and RCRA list at 40 CFR 261, Subpart D, Contractor shall immediately apply hazardous waste labels, if the waste tests hazardous. Label each container of hazardous waste in accordance with 40 CFR 262, and 49 CFR 171-179. Include the following minimum information:

   a. Hazardous Waste. Federal law prohibits improper disposal. If found, contact the nearest police, or public safety authority, or the U.S. Environmental Protection Agency.

   b. Proper DOT Shipping Name.

   c. Manifest Document No.

d. Generator name, address, and EPA ID No.

e. Date of Accumulation

f. EPA or State designated Waste Identification No.

3. Contractor shall enter the above information using permanent marking material, printed in English, and displayed on a background of contrasting color unobscured by other labels or attachments. Locate labeling away from other markings that could substantially reduce its effectiveness.

4. Contractor shall complete the labeling, marking, and placarding activities under the observation of the Engineer, prior to storing or transporting any container.

E. WASTE TRANSPORTATION AND DISPOSAL (WITH THE EXCEPTION OF WASTE WATER AND WASTE WHICH CONTAINS STEEL GRIT)

1. Hazardous Waste – Contractor shall

a. Prepare the hazardous waste manifest for each shipment and provide to the Engineer for review and signature.

b. Arrange for the transportation of all hazardous waste by a licensed transporter in accordance with 40 CFR 263, 49 CFR 171-179, and 6 NYCRR 364. Also comply with applicable City regulations. Verify that all waste is completely covered during transport.

c. Unless specifically approved by the Engineer in writing ensure that, the hazardous waste transporter does not stop enroute either before or after the pickup of hazardous materials from the construction site.

d. Arrange for the recycling or disposal of all hazardous waste in accordance with 40 CFR 264, 40 CFR 268, and 6 NYCRR 373. Verify that only licensed recycling facility or Treatment, Storage, and Disposal (TSD) facilities are used.

e. If the waste is shipped to a TSD facility, notify the facility that stabilization to less than 0.75 mg/L lead is required and provide copy of LDR to the PA.

f. Provide a certification for each manifested shipment that the waste was accepted by the recycling or disposal facility, and properly treated and disposed. Comply with all of the manifesting, certification, and reporting requirements for hazardous waste in accordance with 40 CFR 262, 40 CFR 268, and 6 NYCRR 372, including certificates of final disposal for each shipment.

2. Non-Hazardous Municipal/Construction Waste – Contractor shall

a. Properly transport, and dispose of all non-hazardous municipal construction waste.

b. Verify that waste is completely covered during transport.

c. If toxic metals or hazardous substances were detected during the laboratory testing, notify the disposal facility that such metals or materials are present in the waste.

d. Comply with additional City regulations as applicable as though the Authority were a private corporation.

F. SPECIAL WASTE REQUIREMENTS FOR RECYCLED STEEL GRIT

1. When recycled steel abrasives are used and the resulting TCLP test results of lead concentration between 1 mg/L and 5 mg/L, contractor shall collect, handle, store, and transport the waste in the same manner as if it tested hazardous.

2. Contractor shall notify the waste recycling or TSD facility that the waste contains high levels of lead.

3. If the waste is shipped to a TSD facility, contractor shall notify the facility that further stabilization is required prior to disposal. Use the stabilization methods that would have been used in the event the waste tested hazardous. Stabilize to less than 0.75 mg/L lead.

G. WASTE WATER HANDLING AND DISPOSAL

1. Contractor shall provide containers for the collection and retention of all waste water including but not limited to the water used for steam cleaning, hygiene purposes, laundering of clothing if done on site, decontamination and cleanup activities.

2. Contractor shall filter visible paint chips and particulate from the waste water prior to placing it into the containers. Prior to disposal, provide ample filtration (e.g. through a multi-stage filtration system ending in 5 microns or better if needed). Test the water and filtered waste streams for total toxic metals and for other parameters specified herein.

3. Contractor shall make disposal arrangement with the local publicly owned treatment works (POTW), sanitation company, or other appropriate permitted facility. Provide the Engineer with documentation signed by an official of the facility stating that such facility will accept the waste, and that the levels of any lead, toxic metals and constituents remaining in the waste water are acceptable by the facility.

END OF SECTION

SECTION 02095

CONTAINMENT, WORKER, AND ENVIRONMENTAL PROTECTION

APPENDIX "A"

SUBMITTALS

A. GENERAL - Provide all submittals of this Appendix in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1, General Provisions.

B. PRE-CONSTRUCTION

1. Qualifications, Experience, and Certifications - provide written qualification, experience, and certification information for the following:

   a. Contractor and its Subcontractors

      (1) Provide certifications of the entity who will be performing Lead Abatement Work in accordance with the New Jersey Lead Hazard Evaluation and Abatement Code for Superstructures and Commercial Buildings, at NJAC 5.17 - 2.1.

      (2) Provide evidence of confined space training for workers who will be entering, supervising and attending confined spaces.

   b. Laboratory

      (1) Provide the name, address, telephone number, and contact person and copy of AIHA certification of the laboratory that will be used for the worker and restricted zone exposure monitoring required under this Section.

      (2) Provide the name, address, telephone number, and contact person of the laboratory that will be used for the analysis of waste samples as required by this Section.

      (3) Provide evidence that the analytical laboratory proposed for TCLP testing and waste analysis (i.e. solid and liquid) is experienced to perform full TCLP and waste analysis for all parameters as specified.

   c. Acoustics Firm - submit the name, address, telephone number, and contact person of the acoustics firm that will be employed. Include the names of the employee(s) who will be performing the acoustical design and consulting services under this Contract. Provide the name(s) and telephone number(s) of previous project owners for whom the acoustics firm has provided similar services.

   d. Certified Industrial Hygienist - provide the name, experience, and qualifications of the CIH who will be reviewing, approving and sealing the site-specific Lead Health and Safety Compliance Program.

e. Supervisors and workers:

(1) Provide written confirmation that the supervisors and workers who will be installing the containment system have successfully completed at least one contract of similar size and complexity within two years preceding the Authority's acceptance of the Contractor's Proposal. In the case of abrasive blast cleaning, the project must have involved the use of a containment system equivalent to SSPC Class 1A with negative air pressure.

(2) Provide certifications of supervisors and workers who will be performing Work in the State of New Jersey under New Jersey Lead abatement Supervisor and Worker Programs.

(3) Provide evidence of training for all supervisors and workers responsible for hazardous waste management

f. Competent Person - Provide written confirmation that the person or persons designated as the OSHA competent person meets the requirements for "Competent Person" as stated in 1.05D "Qualifications and Experience".

g. Containment Design Engineers - Provide written confirmation of the license and experience of the Professional Engineers as stated in 1.06 C "Qualifications and Experience".

2. Containment Plans and Drawings - Provide a written description, shop drawings, and calculations for the design and construction of work platforms, and containment and ventilation systems, including, but not limited to the following:

a. Detailed drawings signed and stamped by Professional Engineer(s) licensed in the States of New York and New Jersey. Have the engineer(s) analyze the system for the effects of wind forces on the bridge structure and the containment system itself, and all other maximum live and dead imposed loads (e.g., platforms, equipment, personnel, waste, traffic, etc.). Do not allow the containment system to induce a load on the bridge which will create an overstress condition, exceed the limits given on the Contract Drawings that will be issued for each individual work order, or otherwise affect the structural integrity of the bridge or the containment or temporary structures, and do not allow the system to encroach upon the required bridge clearances.

b. Data, calculations, and assumptions used for the design of the containment and ventilation system and the imposed loads on the existing structure, signed by Professional Engineer(s) licensed in the States of New York and New Jersey. Include the design air flows within containment, and the locations and sizes of air inlets and exhaust ducts and dust collectors. Include calculations for static pressure losses through the system.

c. Dimensioned elevation and sectional views showing all containments and encroachments of waterway or highway traffic created by the containment, debris collection equipment, and ventilation or recycled abrasive systems.

d. The plan for staging, installing, moving, and removing the containment; and the methods of attachment that will be used. Make attachment points to specific, substantial framing members only, as approved by the Engineer. Design the containment in order for it to be disassembled and secured within one hour of notification, such as under inclement weather conditions. Design it in such a manner that it is capable of being disassembled during high wind conditions of at least 40 mph.

e. Include the methods of access that will be provided to work areas inside containment, locations of safety lines, and locations of containment entryways.

f. The methods and procedures that will be used for cleaning and securing the containment at the end of each work day, and the cleaning undertaken prior to dropping or relocating the containment.

g. Controls that will be exercised to prevent excessive sagging during cable installation (e.g., temporary cradles) to ensure the protection of traffic.

h. Plans for maintaining roadway lighting and signage, navigational and aviation lighting, weather station located at the New York side stair tower during the Work, as applicable.

i. Plans for the collection and removal of debris from the surface of water when working over streams, rivers, lakes, and other bodies of water.

j. Technical data sheets, specification sheets, any other information needed to thoroughly describe the containment plan and materials proposed for use. Include a two (2) sq. ft. sample of each of the proposed enclosure material(s), together with the manufacturer's specifications on light transmittance, flame spread, and fuel contributed, burst strength, abrasion durability, and unit weight of material.

k. A description of debris collection and air filtration equipment, including the equipment data sheets, airflow capacity, fan curves, equipment weights and temporary utility service requirements.

l. Information on any temporary heating units proposed for use, fuel to be used and the safety measures to be employed for heater use and fuel storage.

m. The methods and procedures that will be used to control spills or releases of dust or debris into the environment.

n. Provide the plan for monitoring the soundness of the containment during weekends, holidays, or extended shut downs. Provide the procedures for mobilizing crews to the site to initiate the emergency demobilization plan in the event of inclement weather, and the plans for the immediate removal of snow and ice from the containment structure.

3. Plan for Monitoring of Weather and Wind Conditions

a. Provide catalog cuts of radios that will be used to monitor weather conditions and wind velocity, and the name, address, phone number, and contact of the weather service that will be used and a copy of the contract with the weather monitoring service.

b. Provide the plan for monitoring weather and wind conditions, including the procedures that will be followed to communicate impending inclement weather to the field Supervisor/foreman and Engineer through the use of mobile phones, and the faxing of weather information to the Engineer when deciding whether or not to lower containments.

c. Provide the plan for monitoring of weather conditions during weekends, holidays, or other shut down periods.

d. Provide contact names and phone numbers of Contractor personnel responsible for monitoring weather, inspecting the containment and performing emergency demobilization in the event of inclement weather.

4. Emergency Containment Demobilization Plan

a. Provide a detailed plan for dropping the containment within 1 hour of the notification of inclement weather, such as sustained wind speeds of 40 mph or greater, or heavy snow.

b. Include the methods and procedures that will be followed to assure that:

(1) All equipment and tools are secured,

(2) The containment is cleaned of loose dust and debris,

(3) All containment system roof and wall enclosure elements that could contribute to adding wind load to the bridge structure are removed or lowered (excluding containment framing), and

(4) Snow and ice are routinely removed from the containment.

5. Lead (Toxic Metal) Health and Safety Compliance Program - Submit the following plans, programs, and information addressing worker health and safety from exposure to lead and other toxic metals. Note that this program is in addition to other OSHA hazard communication and health and safety requirements including scaffolding, electrical safety and general construction safety requirements of OSHA.

a. Provide a written, project-specific Lead (Toxic Metal) Health and Safety Compliance Program under the direction of, and signed and sealed by, a Certified Industrial Hygienist (CIH). Identify the methods of compliance that will be used to reduce worker exposures to toxic metals including engineering and waste practice controls.

b. Include the methods and procedures that will be followed for complying with this Section and any OSHA standards published for the toxic metals present in the paint (e.g., 29 CFR 1926.62 for lead, 29 CFR 1926.1127 for cadmium, and 29 CFR 1926.1118 for inorganic arsenic). When toxic metals are present in the paint for which OSHA has not developed a comprehensive health and safety standard, include statements that the workers will not be exposed above the PEL established for the metal as identified in 29 CFR 1926.55.

c. Rely on respiratory protection only after feasible engineering and work practice controls have been implemented to reduce airborne exposures.

d. Include the name of the competent person who will be making routine inspections of Work activities to ensure compliance with the program, and the frequency of inspections that will be made.

e. Verify that any subcontractors working for the Contractor are included in the program or in a separate program which meets the requirements of this Section. If subcontractors are operating under a separate program, include the program(s) with the submittals.

f. Revise and update the program as needed and at least every six months during the portion(s) of the Work which involve the disturbance of toxic metals. Verify that the CIH signs off on all six-month reviews and revisions.

g. Outside Laundry - Provide the name, address, and qualifications of the launderer, if one will be used, for the cleaning of reusable clothing. Provide a letter from the laundry indicating that it is permitted to handle clothing contaminated with lead and/or the other toxic metals of concern. Provide a copy of a letter to the laundry informing it that the clothing from the Work is contaminated with lead or other toxic metals and that the laundry must have procedures in effect to handle such clothing.

h. Personal Protective Equipment for Engineer Use - Acknowledge that all protective clothing and equipment, laundering or disposal, and hygiene facilities will be provided for up to four Engineer representatives.

6. Plan for Establishing Restricted Zones - Submit a plan for the establishment of restricted zones around equipment and operations that may generate emissions of dust or debris containing lead or other toxic metals. Include the methods that will be used for instrument monitoring and designating the restricted zones.

7. Environmental Compliance Plan - Submit an Environmental Compliance Plan which establishes programs for the monitoring activities that will be undertaken under the Contract:

a. Assessments of Visible Emissions and Releases - A written program for the observation of visible emissions during the performance of the Work, and inspections for releases or spills of dust and debris that become deposited on surrounding equipment, property, soil, water, and sediment. Include the frequency and methods of observation and inspection that will be made, areas or work activities that will be observed, and the frequency and nature of clean up that will be undertaken. Include the name(s) and qualifications of the personnel conducting the observations and inspections.

b. Ground (Soil) Evaluations - A written program for the inspection of the ground and soil prior to commencement of the Work and upon completion to assure that the ground has not been impacted by the Work.

c. Water/Sediment Evaluations - A written program for the inspection of the water and sediment prior to commencement of the Work and upon completion to assure that the water and sediment have not been impacted by the Work.

d. Final Cleaning/Clearance Evaluations - A written program identifying the procedures and methods that will be used to conduct final clean up, and final visual cleanliness inspections and evaluations.

e. Include a statement that the Contractor will undertake all clean-up and remediation necessary to return the soil, water, and sediment to pre-job conditions in the event that sampling and analysis conducted by the Authority show that contamination has occurred, at no additional cost to the Authority.

8. Noise Abatement Plan

a. Provide a written noise abatement plan which establishes the programs for mitigation of noise pollution generated from the Work, to comply with the noise mitigation criteria established in 3.02 A., herein.

(1) Include the means and methods that will be employed to comply with the criteria set forth in 3.02 A., herein.

(2) Required measurements shall be supervised by an acoustician who is either a Board Certified Member of Noise Control Engineering or a Principal of a Member Firm of the National Council of Acoustical Consultants.

(3) All design drawings of noise abatement enclosures and barriers shall be signed and sealed by a Professional Engineer licensed in the States of New York and New Jersey.

b. Provide description of noise mitigation to be employed, including the name of the manufacturer of any material used and its specifications.

c. Provide catalog cuts and technical data sheets of construction equipment to be employed during Work of this Contract.

d. Submit for review all acoustical and structural capacity calculations, including wind load, and drawings for each enclosure or barrier, with certification that such enclosures and barriers conform to all structural, clearance, or other requirements that may be included elsewhere in this Contract.

9. Transporter Qualifications, Experience, and Permits

a. Provide the names, addresses, qualifications, and contact person for the proposed transporter(s) of hazardous waste, non-hazardous waste, and waste water.

b. Provide evidence that each transporter has current registration approved by NYSDEC and NJDEP, as applicable. Hazardous waste haulers are required to have a 6 NYCRR, Part 364, Waste Transporter Permit.

c. Ensure that hazardous waste haulers are required to possess a Spill Prevention, Control and Countermeasure (SPCC) plan. Provide evidence of such a plan.

d. If it is proposed that the transportation pass through other states, provide evidence that the transporter complies with the applicable transportation regulations of the respective states.

10. Hazardous Waste and Waste Water Disposal Facility Qualifications, Experience, and Permits

a. Provide the name, address, telephone number and contact person for each waste disposal facility proposed for use in the Contract, including but not limited to hazardous, non-hazardous, and waste water.

b. Provide evidence that each disposal facility has current registrations and permits for the operation of such facilities, or written approval from the state (and by the USEPA or other local agency, if applicable) in which it operates.

c. Provide evidence that each disposal facility maintains current state Pollution Discharge Elimination System Permits, if applicable.

d. If recycled steel grit abrasives will be used, advise the facilities that the lead paint waste must be handled and stabilized as if it tested hazardous. Provide the proposed means of stabilization that will be used by the facility to comply with the requirements of this Section.

e. If it is proposed that a secondary smelter will be used for the recycling of the waste, provide evidence that the smelter holds a valid EPA and consignment waste approval for the treatment of the hazardous materials present in the waste that will be generated (e.g., D008 in the case of lead-containing waste).

f. If the Contractor proposes to discharge waste water directly into the sewer system, provide a written permit or written documentation from the local sewer district which provides approval of such activities.

g. Advise each legally permitted recycling or waste disposal facility that bridge paint debris will be generated (e.g., lead paint debris, water), and identify the toxic metals that the waste will be likely to contain.

(1) Based on the above information, provide a letter from each of the proposed hazardous waste recycling or disposal facilities, stating that the facility can accept this type of waste, is authorized to accept the waste under the laws of the State of residence; has the required capability to treat and dispose of the materials; and will provide or assure the ultimate disposal method indicated on the Uniform Hazardous Waste Manifest.

(2) Provide a letter from the proposed waste water disposal facility, indicating that the facility has the capability to handle and properly dispose of the waste water.

(3) Provide the Engineer with the original letters signed by a legally authorized representative of each facility.

11. Provide evidence that during the last twelve (12) months, each proposed disposal facility has not incurred:

a. a.more than five (5) Notice of Violations (NOVs) related to accepting unpermitted haulers, or accepting waste containing contamination above the facility's permit limits;

b. more than three (3) NOVs related to poor housekeeping, such as spills of chemicals or petroleum products that could contaminate soil and ground water; and

c. an Administrative Consent Order (ACO) related to ground water remediation.

12. Non-hazardous Waste Disposal Facility Qualifications, Experience, and Permits - Provide the name, address, telephone number, contact person, and permit for each waste landfill that will accept the non-hazardous waste generated by the Contractor.

13. Waste Handling Plan - A written program that addresses the proper handling and disposal of all waste. Include the procedures and equipment that will be used for:

a. the collection of waste water, paint, spent abrasive and paint chips and other debris, and its transportation to the storage area identified by the Engineer or on the Contract Drawings;

b. the collection of representative samples of waste for testing;

c. the testing and analysis procedures that will be used;

d. the determination of hazardous waste and non-hazardous waste streams, as defined in 40 CFR 261.2;

e. the site handling, storage, packing, and labeling of the waste.

14. Contingency Plan and Emergency Procedures

a. Submit a Contingency Plan and Emergency Procedures to respond to fires, explosions, or any unplanned sudden or non-sudden releases of hazardous waste or hazardous waste constituents to air, soil, or surface water at the Work site.

b. The plan must describe arrangements agreed to by local police departments, fire departments, hospitals, and state and local emergency response teams.

c. The plan must list names, addresses, and phone numbers of all persons qualified to act as emergency coordinators; and include a list of all emergency equipment at the Work site (fire extinguishers, spill control equipment, communications and alarm systems and decontamination equipment).

d. The plan must include an evacuation plan for workers, describe signals to be used to begin evacuation, identify routes and alternate evacuation routes.

e. Submit evidence that a copy of the plan has been submitted to all local police departments, fire departments, hospitals, and State and local emergency response teams that may be called upon to provide emergency services.

C. CONSTRUCTION START-UP

1. Containment Lowering, Removal, and Relocation - Unless directed otherwise by the Engineer, prior to beginning any paint removal operations, demonstrate:

a. The lowering and removal, within one hour, of those elements of the containment system which contribute wind loads to the bridge, and that the lowering and removal can be performed under high wind conditions of at least 40 mph.

b. The removal, within one hour, of those elements of the containment system which are above the roadways, railways and navigation channel or waterways.

c. Confirm the results of the demonstration in writing and provide to the Engineer prior to the commencement of paint removal operations.

2. Certification of Containment Installation

a. Prior to working within each containment, submit a letter signed and sealed by the containment design engineer, stating that the containment system has been assembled as shown on the approved, signed and sealed drawings.

b. If the containment is not installed in accordance with the design drawings, issue supplemental calculations for the new design for Engineer review and approval in accordance with the original submittal requirements.

D. CONSTRUCTION PHASE

1. Maintain and make available for Engineer review, a daily (in New Jersey) and weekly (in New York) inspection log of hazardous waste storage.

2. Provide a complete analytical package of TCLP test results of waste samples within 15 days after sample collection, but not later than 45 days after start-up.

3. Provide a complete analytical package of waste water test results of waste sample collection within 15 days after sample collection, but not later than 45 days after start-up.

4. Waste Manifests - Submit to the Engineer one copy of:

   a. Executed and signed manifests for each load of waste material transported from the Work site. Provide the manifest to the Engineer within one day of shipment.

   b. Executed waste manifest form signed by a responsible party of the disposal facility. Provide the form within one day of receipt. If the copy is not received within 35 days from the date of shipment, contact the Engineer, and assist as directed, in efforts to locate the shipment, and in the completion of the EPA Exception Reports (if the signed manifest is not received within 45 days of the date of shipment).

   c. Certificate of final disposal for each manifest or certificate of recycling for recycled material. Provide the certification within one day of receipt.

5. Bills of Lading - Provide bills of lading for the disposal of all non-hazardous municipal/construction waste within one week of the date of shipment.

6. Waste water - Provide written documentation of the receipt of disposal of all waste water within one week of the date of shipment.

7. Containment scaffolding inspection log - maintain, and make available for review by the Engineer, a daily log of the inspections of scaffolding, platforms, and wire ropes in accordance with the OSHA requirements. Conduct the inspections each shift, and after any occurrence which could affect the structural integrity of the scaffolding or wire suspension ropes.

8. Temporary Heating Units - If the use of temporary heating units was not anticipated at the time of the initial submittals, notify the Engineer at least one week in advance of use of heating units. Submit, for approval, information on fuel to be used and the safety measures to be employed for heater use and fuel storage.

9. Weather Conditions - submit to the Engineer, one copy of each FAX weather transmission containing the wind velocity information used to decide whether or not the containment enclosure(s) should be lowered.

10. Acoustical Tests - submit three copies of all acoustical test results to the Engineer within two calendar days of testing.

11. Medical Surveillance Summary

a. Provide the Engineer with letter reports signed by a CIH which summarize employee medical surveillance results that are indicative of worker exposures to (or which demonstrate proper protection from) toxic metals. In the case of lead, summarize the blood lead and ZPP results, indicate any observed trends, and identify worker removal provisions that were invoked based on the results. Provide reports to the Engineer within 15 days of each testing period.

b. Provide summary reports of test results prior to exposing workers to toxic dust, emissions or releases, periodic surveillance results, and results upon completion of site exposures. Provide the Engineer with an original signed copy of each report within 5 calendar days after receipt of the test results, but no later than 10 days after sampling.

12. Personnel and Restricted Zone Air Monitoring - report all employee and restricted zone air monitoring exposure results to the Engineer verbally within one day of receipt, and in writing within one week thereafter.

13. Restricted Zone Log - Maintain and make available for Engineer inspection, permanently bound log(s) for the signatures of all individuals entering and leaving restricted zones.

14. Visible Emissions and Releases

a. Maintain and make available for Engineer inspection a permanently bound log for the documentation of daily inspections and the documentation of unusual incidents or releases.

b. Provide the Engineer with an immediate verbal report each time that Work has been halted due to unacceptable visible emissions or releases. Include the cleanup activities invoked, and the corrective action taken to avoid a recurrence. If the release represents a reportable quantity, identify the amount of material (e.g., lead) released and the notifications that were made. Provide a written report within 2 days of the incident.

c. Summarize the results of all visible emissions assessments in a monthly report. Provide monthly report to the Engineer within 15 days of the last workday of the previous month.

15. Construction Site Clean-up - Prior to issuance of Certificate of Final Completion, provide the Engineer with a letter report presenting the results of the inspections conducted to verify the final cleanliness of the construction site, surrounding property, waterways, equipment, buildings, and structures. Provide the final clearance report within 10 days of the final inspection.

END OF APPENDIX "A"

Section 02095 - Table 1

Containment Criteria for Removal of Paint Containing Lead and Other Toxic Metals[1]

Containment Removal Method	Containment SSPC Class[2]	Containment Material Flexibility	Containment Material Permeability[3]	Support Structure	Material Joints	Containment Entryway	Ventilation System Required	Negative Pressure Required	Exhaust Filtration Required
Hand Tool Cleaning[4]	3P	Rigid or Flexible	Permeable or Impermeable	Minimal	Partially Sealed	Overlapping or Open Seam	Natural	No	No
Power Tool Cleaning w/ Vacuum[4]	3P	Rigid or Flexible	Permeable or Impermeable	Minimal	Partially Sealed	Overlapping or Open Seam	Natural	No	No
Power Tool Cleaning w/o Vacuum[5]	2P	Rigid or Flexible	Permeable or Impermeable	Rigid or Flexible	Fully or Partially Sealed	Overlapping or Open Seam	Natural[5]	No	No[5]
Chemical Stripping[6]	3C	Rigid or Flexible	Permeable or Impermeable	Minimal	Partially Sealed	Open Seam	Natural	No	No[6]
Wet 2W-3W Methods[7]	Rigid or	Permeable or Flexible	Rigid, Flexible, Impermeable	Partially or Minimal	Overlapping or Sealed	Natural[7] Open Seam	No	No[7]	
Abrasive Blast Cleaning[8]	1A	Rigid or Flexible	Impermeable	Rigid or Flexible	Fully Sealed	Airlock or Resealable	Mechanical	Yes	Yes

[1]This table provides general design criteria only. It does not guarantee that specific controls over emissions will occur because unique site conditions must be considered in the design. Other combinations of materials may provide controls over emissions equivalent to or greater than those combinations shown above.

[2]The SSPC Classification is based on SSPC Guide 6. Note that for work over water, water booms or boats with skimmers must be employed, where feasible, to contain spills or releases. Debris must be removed daily at a minimum.

[3]Permeability addresses both air and water as appropriate. In the case of water or chemical removal methods, the containment materials must be resistant to both chemicals and water. Ground covers should always be impermeable, and of sufficient strength to withstand the impact and weight of the debris and the equipment used for collection and clean-up.

[4]Ground covers and/or free hanging tarpaulins may provide suitable controls over emissions without the need to completely enclose the work area.

[5]Ventilation is not required provided the emissions are controlled as specified in this Section, and provided worker exposures are properly controlled. If unacceptable worker exposures to lead or other toxic metals occurs, incorporate a ventilation system into the containment.

[6]Ground covers must always be impermeable and of sufficient strength to withstand the weight and impact of the debris and the equipment used for cleaning. If debris escape through the seams, then additional sealing of the seams and joints is required. All containment materials and materials used for sealing must be resistant to both chemicals and water. If unacceptable worker exposures to lead or other toxic metals occurs, incorporate a ventilation system.

[7]This method applies to pressure washing, high pressure water jetting with and without abrasive, and wet abrasive blast cleaning. Although both permeable and impermeable containment materials are included, ground covers and the lower portions of the containment must be water impermeable with fully sealed joints, and of sufficient strength and integrity to facilitate the collection and holding of the water and debris for proper disposal. Ventilation is not required provided the emissions are controlled as specified in this Section, and provided worker exposures are properly controlled. If unacceptable worker exposures to lead or other toxic metals occurs, incorporate a ventilation system into the containment.

[8]Ground covers must be of sufficient strength to withstand the impact and weight of the abrasive and the equipment used for cleaning. Ground covers must also extend beyond the containment boundary to capture escaping debris. If vacuum blasting is employed, ground covers and/or free hanging tarpaulins may provide suitable controls over emissions without the need to completely enclose the work area.

DIVISION 2

SECTION 02096

WORK IMPACTING NON-AUTHORITY UTILITIES

PART 1. GENERAL

1.01 SUMMARY

A. The work in this section includes special construction required for service utilities that are publicly, privately or cooperatively owned. Such work includes maintaining and/or relocating a utility during the construction period based on the requirements of the Non-Authority utility Owner. Requirements set forth herein are in addition to and shall be considered as complementary to the balance of the work shown in the Specifications and the Contract Drawings.

1.02 RELATED SECTIONS

A. *Division 1* *General Provisions*

B. Section 02221 Excavation, Backfilling and Filling

1.03 OWNERSHIP OF NON-AUTHORITY UTILITIES

A. Owners of non-Authority utilities may include, but are not necessarily limited to:

1. New York State Department of Transportation
2. New York City Department of Environmental Protection
3. Fire Department of New York City
4. New Jersey Department of Transportation
5. Bayonne Municipal Utilities Authority
6. Consolidated Edison Company of New York, Inc.
7. National Grid
8. Public Service Enterprise Group Incorporated (PSE&G)
9. Empire City Subway
10. Verizon
11. AT&T

1.04 AGREEMENTS AND PERMITS

A. With the concurrence of the Engineer, enter negotiations with the applicable utility owners and execute agreements for the intended work.

1. Agreements may cover all or some of but are not limited to the following:
   a. Protection of utilities
   b. Obtain and pay for permits which are required by the Non-Authority utility Owner
   c. Repairs of damages to the satisfaction of utility owner

d. Provide and pay for special insurances if required by the Non-Authority utility Owner

B. Comply with the terms of these agreements and any modifications thereof and obey the directions of the Non-Authority utility Owners. Refer to the net cost item list contained in the General Notes of the Contract Drawings in regards to costs pertaining to temporary relocations of non-Authority utilities.

1.05 SPECIAL RESTRICTIONS

A. Pay owners of private properties for the special usage of their employees and/or equipment in conjunction with this Contract. Examples include:

1. Flaggers
2. Watchmen
3. Surveyors
4. Inspectors
5. Others

B. Maintain in effect agreements with owners until the issuance of the Certificate of Final Completion or the termination of all warranty periods following the date of Substantial Completion, whichever is later.

C. Nothing contained herein and no act of the Contractor in his performance of this Contract AKB-264.039 shall create or be deemed to create:

1. any relationship in Contract or otherwise between the Authority and any third party, including but not limited to any Non-Authority utility Owner, or
2. any rights in any third party or any obligation on the part of the Authority to any third party, including but not limited to any Non-Authority utility Owner.

PART 2. PRODUCTS

2.01 MATERIALS

A. Materials shall meet the requirements specified by the respective Non-Authority utility Owner and the Engineer.

PART 3. EXECUTION

3.01 GENERAL

A. Existing utilities shown on the Contract Drawings have been identified by field survey performed by KS ENGINEERS. There may be unknown utilities not shown on the KS ENGINEERS utility survey drawings. Refer to KS ENGINEERS utility survey drawings included in the Contract Drawings for information pertaining to the location, elevation and size of existing utilities.

1. Verify the location of existing underground utilities within the area prior to construction and exercise extreme caution when working adjacent to existing power, communications, water, petroleum or natural gas lines to prevent damage to these lines.

B. Take all necessary precautions to and prevent interference with and damage to utilities and other facilities during the course of construction. The cost of all work connected with maintaining and protecting utilities affected by the work of the Contract shall be borne by the Contractor and the cost be included in the price bid for various items in the contract. Refer to the net cost item list contained in the General Notes of the Contract Drawings in regards to costs pertaining to permanent relocations of private utilities not shown on the Contract Drawings.

C. In the event the Contractor damages an existing utility or interrupts non-Authority utility service, the Contractor shall immediately notify the non-Authority utility Owner and the Engineer, and shall commence and complete, at no cost to the Authority, repair/replacement work as instructed by the Engineer.

1. In the event the Contractor causes an interruption in utility service, the Contractor shall immediately arrange for service to be restored and may not cease the repair work until service is restored. The Contractor may not continue construction operations until service is restored, unless otherwise directed by the Engineer.
2. All corrective utility work shall be acceptable to the Engineer and the subject non-Authority utility Owner.
3. If any utilities are damaged and the necessary repairs are not satisfactory to the Engineer, the work may be performed by the respective utility company and the cost thereof charged against the Contractor.
4. The cost associated with the repair of the utility and resumption of service shall be at Contractor's expense.

D. The Contractor shall contact the non-Authority utilities and inform them what construction equipment will (1) pass over, (2) operate above the underground utilities, (3) operate in the vicinity of above ground utilities, and shall request from the non-Authority utilities information about the protective measures or relocations required. Furnish and install timber plates, as a minimum, to spread the load wherever heavy equipment passes over or operates above underground utilities.

END OF SECTION

DIVISION 2

SECTION 02100

PERMANENT SURVEY MARKERS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for work consisting of furnishing, installing, and certifying permanent survey markers in accordance with the details shown on the contract drawings and appropriate NYSDOT and NJDOT Standard Sheet as reference drawings in the contract documents.

1.02 SYSTEM DESCRIPTION

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

New York State Department of Transportation (NYSDOT) Standard Specifications.

New Jersey Department of Transportation (NJDOT) Standard Specifications.

American Society for Testing and Materials (ASTM International)

ASTM B19	Monument Markers
ASTM A615	Reinforcing Steel, Grade 300 or 420
	Compliance with the following, as applicable
AASHTO M105	Monument Boxes, Class 20A or 20B (NJDOT)

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. The concrete shall meet the requirements of Section 03301 Portland Cement Concrete. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Engineer. The Contractor shall submit for approval by the PANYNJ Materials Engineer, a mix of at least equivalent to the specified Concrete.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. EXECUTION

2.01 PREPARATION

A. Perform a site investigation within the project limits to locate existing property markers and monuments. Protect property markers and monuments from disturbance and destruction. Notify the engineer of the location of property markers and monuments that are in danger of being removed or disturbed. Do not remove or disturb existing property markers and monuments until obtaining approval from the engineer.

2.02 INSTALLATION / or ERECTION / or APPLICATION

A. Permanent survey markers shall be installed in accordance with the appropriate State agency standard sheets at the locations described in the contract documents and approved by the Engineer prior to installation. The sequential numbering required on the permanent survey marker caps shall be coordinated with the Engineer and the PANYNJ Land Surveyor.

B. The Land Surveyor shall certify the as-built location of each installed permanent survey marker on certification forms provided by the Engineer, including contract information, as-built State Plane adjacent markers, the elevation of the marker, and a sketch which shows the relative positions to the control line points, four physical ties to the markers, and a north arrow.

C. Permanent survey markers in the state of New York shall be installed as per section 625 of the current version of the NYSDOT standard Specifications.

D. Permanent survey markers in the State of New Jersey shall be installed as per Section 157 of the current version of the NJSDOT standard specifications.

END OF SECTION

SECTION 02100

PERMANENT SURVEY MARKERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

B. Record Documents - Once monuments are installed, submit a survey, signed and sealed by the land surveyor to the Resident Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02110

EXCAVATION, STAGING, HANDLING, TRANSPORTATION, AND DISPOSAL OF HAZARDOUS MATERIALS FOR THE WEST FIRST STREET SITE IN BAYONNE, NEW JERSEY

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for furnishing all labor, materials, tools, and equipment, and performing all operations necessary for excavation, staging, handling, transportation and disposal of hazardous waste encountered during execution of the Work. The Contractor shall comply with the design specifications, regulatory and other requirements to be provided in the contract drawings under the direction of and as approved by the Licensed Site Remediation Professional (LSRP) of Record for the project.

B. Related Work specified in other Sections of the Specifications includes the following:

1. Section 02050 – Demolition Work
2. Section 02112 – Excavation, Staging, Handling, Transportation, and Disposal of Non-Hazardous Materials for the West First Street site in Bayonne, New Jersey
3. Section 02145 - Dewatering
4. Section 02221 – Excavation, Backfilling, and Filling
5. Section 02272 – Soil Erosion and Sedimentation Control
6. Section 02895 – Disposal of Hazardous Materials

1.02 CITED STANDARDS

A. Regulatory Requirements:

1. Code of Federal Regulations (CFR):
   a. 29 CFR 1910 – Occupational Safety and Health Standards (OSHA).
   b. 40 CFR 260 – Hazardous Waste Management System: General.
   c. 40 CFR 261 – Identification and Listing of Hazardous Waste.
   d. 40 CFR 262 – Standards Applicable to Generators of Hazardous Waste.
   e. 40 CFR 263 – Standards Applicable to Transporters of Hazardous Waste.
   f. 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.
   g. 40 CFR 273 – Universal Waste Regulations.

h. 40 CFR 761 – Toxic Substances Control Act (TSCA).

i. 49 CFR 107, 110, 130, 171, 172, 173, 177, 178, 180 – Research and Special Programs Administration, Department of Transportation (Hazardous Materials Regulations).

j. 49 CFR 397 – Federal Motor Carrier Safety Administration, Department of Transportation (Transportation of Hazardous Materials).

2. New Jersey Uniform Construction Code (NJUCC)

3. New Jersey Department of Environmental Protection (NJDEP):

a. N.J.A.C 7:26E, Technical Requirements for Site Remediation.

b. N.J.A.C. 7:26D, Remediation Standards.

c. N.J.A.C. 7:26C, Administrative Requirements for the Remediation of Contaminated Sites.

d. N.J.A.C 7:9C, Groundwater Quality Standards.

e. Solid Waste Regulations, N.J.A.C. 7:26.

f. Hazardous Waste Regulations, N.J.A.C. 7:26G.

g. Surface Water Quality Standards, N.J.A.C. 7:9B.

h. Guidance Document for the Remediation of Contaminated Soils, January 1998.

i. Field Sampling Procedures Manual, August 2005.

j. Guidance for the Sampling and Analysis of Concrete Designated for Recycling, June 2007.

4. United States Environmental Protection Agency (USEPA):

a. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C s/s 9601 et seq.

b. Resource Conservation and Recovery Act (RCRA) 42 U.S.C. s/s 321 et seq.

1.03 NOTED RESTRICTIONS

A. All hazardous soil and other hazardous waste shall be removed from the Work Site and delivered to the Port Authority approved Hazardous Waste Treatment, Storage, and Disposal (TSD) facility, and as approved by the LSRP for the project, within 90 days of the generation start date. Proper containment and dust controls must be in place during this time, as determined by the LSRP.

B. Do not move any hazardous soil and other hazardous waste from their original Work Site to any other location on the Work Site without express written permission from the Engineer and as approved by the LSRP for the project.

C. All employees of the Contractor and subcontractors involved in the Work shall possess all permits and/or licenses required under the Toxic Substance Control Act (TSCA), the Resource Conservation and Recovery Act (RCRA), as well as any Federal, State or Local permits or licenses required, for the removal, transportation, and disposal of hazardous waste.

D. All hazardous waste removed hereunder shall be lawfully treated and/or disposed of at an Environmental Protection Agency (EPA) approved Treatment, Storage and Disposal Facility (TSD), in accordance with all applicable Federal, State and local laws and regulations, including the New Jersey Department of Environmental Protection (NJDEP).

E. At the time of disposal of hazardous waste, completed shipping documents which contain the information required under N.J.A.C. 7:26 (hereinafter the "Manifest Form") shall be provided.

1. Item #1 on the Manifest, "Generator's US EPA Identification Number", shall be obtained from Port Authority.

F. In addition, provide Certificates of Destruction or Certificates of Disposal, which specify that the hazardous waste has been properly disposed of by the TSD. Such Certificates shall include references to the Manifest Form for the original shipment from Port Authority property and the final shipment to the ultimate treatment or disposal site as well as the address and the EPA identification number for the generator facility. Port Authority and the LSRP for the project shall have the right to inspect and verify quantities of hazardous waste removed.

G. All TSD Facilities and transporters for the treatment and/or disposal and transport hazardous waste picked up hereunder shall be approved for use by Port Authority and the LSRP for the project prior to any removal from the Work Site. Port Authority and the LSRP reserve the right to inspect all transporters, equipment storage facility, and TSD facility at any time prior to or subsequent to the award of this Contract.

H. Should any problems arise regarding the TSD facility chosen to accept waste, including hazardous soils, for treatment and disposal that would require the return of the waste to Port Authority or shall such TSD facility have violated any environmental regulation which would result in any regulatory enforcement action, a notification shall immediately be submitted to the Engineer in writing of such situation, and make provisions for the lawful storage of this waste, until an alternate TSD facility is located by the Contractor and approved by the Engineer and the LSRP for the project.

1.04 QUALITY CONTROL

A. Verify that hazardous soil and other hazardous waste analytical results are consistent with applicable regulatory requirements specified herein. Verify compliance with standards and regulations, including 40 CFR 261, 40 CFR 761, N.J.A.C. 7:26, RCRA, regulatory and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP for the project.

B. Verify that sampling activities and analytical methods are in accordance with applicable regulatory protocols, referenced standards, and regulations specified herein, CERCLA, RCRA, and NJDEP sampling guidelines and protocols, and those to be provided in the contract drawings as required by the LSRP for the project.

C. Ensure that all employees handling hazardous waste, including subcontractors, are qualified and experienced in the work of sampling, preparing, removing, handling, and disposing of the hazardous waste to be performed under this Contract. All employees shall be properly trained, certified in the pertinent environmental regulations and in personal protection, and other safety procedures. Contractor's foreperson shall have a minimum of three years experience in successful completion of similar projects. Verify compliance with 29 CFR 1910.

D. Use a laboratory entity as stipulated in Section 1.05B.

E. General demolition procedures are specified in Section 02050.

F. Pursuant to review or direction by the Engineer and as approved by the LSRP for the project, the Contractor may be required to stockpile excavated materials off-site, or perform in-situ characterization of soil and/or groundwater. Contractor would provide locations where soil and other materials shall be stockpiled and stored for sampling and characterization before disposal. All soil and other materials shall be protected from precipitation, stormwater runoff, and erosion. Storage location(s) shall be secured with access restricted to authorized personnel only.

G. All TSD Facilities and transporters which Contractor intends to use to treat and/or dispose and transport hazardous soils and other hazardous waste shall be reviewed by the Engineer and approved by the LSRP for the project before any removal under this Contract. Verify compliance with 40 CFR 262-264.

1.05 DELIVERABLES

A. Within 90 days after completion of the work, provide final closure report and documentation including at a minimum, the following:

1. Photo documentation.

2. Summary of sampling efforts and results of laboratory analysis for material disposal and end-point sampling results.

3. Executed hazardous waste manifests for each load of respective material removed and transported from the Work Site, and manifests for material associated with decontamination.

4. Executed hazardous waste manifest form signed by a responsible party of the TSD Facility. .

5. Certificate of final disposal (or destruction) for each manifest.

B. Provide any other documentation requested for review by the Engineer and as required by the LSRP to conform or comply with all applicable laws, codes, ordinances, and regulations.

PART 2. PRODUCTS

2.01 MATERIALS

A. 10-mil-thick PVC sheeting shall be used as soil and ballast stockpile liner and covers, which shall cover a firm and dry surface. All joints in the PVC sheeting shall overlap a minimum of 12 inches at the ends. Contractor may also use roll offs or gondolas lined with a minimum 10-mil PVC sheeting for the stockpiling of materials. The Contractor shall comply with the design specifications, regulatory and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP for the project.

B. Refer to Section 02273 for further details.

C. The Contractor shall provide, install and maintain any temporary loading facilities on site as required until completion of material handling activities. Temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles in accordance with Section 02273 or as provided in the contract documents and required by the LSRP.

D. Containers shall be as required in the United State Department of Transportation (DOT) regulations.

E. The Contractor shall assure that the waste hauler's appropriate choice of vehicles and operating practices shall prevent spillage or leakage of contaminated material from occurring en route.

PART 3. EXECUTION

3.01 PREPARATION

A. Before construction activities, identify areas of hazardous materials that will be disturbed by construction as described in the Contract Drawings.

B. Locate, identify, and protect all utilities within the area of work from damage.

C. Protect all benchmarks, survey control points, boring locations, monitoring wells, and piezometers from damage or displacement during removal, handling and disposal activities at the Work Site.

D. Construct a soil staging area for hazardous materials that may be stored up to 90 days before off-site transportation and disposal as specified herein to comply with all applicable regulations.

3.02 COORDINATION

A. Request for waste disposal clearances, and permits through the Engineer and LSRP.

3.03 WORK AREA CONDITIONS

A. Representatives of NJDEP may be at the Work Site. Cooperate with and give assistance to such representatives, upon review by the Engineer.

B. Contractor's Safety Supervisor/Representative shall be present at the Work Site at all work times.

C. Display or have available at all times at the Work Site a copy of the accepted CHSP and SWP documents.

3.04 CLEARING

A. Clear areas required for access to the Work Site and execution of the Work.

3.05 EXCAVATION, STAGING, HANDLING, TRANSPORTATION, STORAGE AND OF HAZARDOUS MATERIALS

A. Excavation activities will commence following as needed dewatering, and the materials excavated will be stockpiled onsite on plastic, with appurtenant containment to control pore water drainage. The Contractor shall comply with the remediation permit-by-rule provisions at N.J.A.C. 7:14A-7.5 for any discharges for dewatering at the site.

B. Stockpile excavated soil and other materials in a designated storage location and protect from precipitation, erosion, and stormwater runoff in accordance with the design specifications, regulatory and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP for the project.

C. All soil and other material must be removed from the soil staging area and delivered to the TSD Facility within 90 days of the generation start date. Do not move any soil or other materials from their original Work Site to any other Work area without express written permission from the Engineer as approved of by the LSRP.

D. Stockpiles shall be of manageable size and designed to protect the soil from precipitation, runoff, and erosion, as shown in the design specifications and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP.

E. Restrict access to the area to authorized personnel only.

F. Design storage areas to prevent leakage from the stockpiled materials from entering surrounding soils or waters. Line and cover stockpiled areas with 10-mil-thick impervious, PVC sheeting or otherwise as shown in the design specifications, and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP.

G. Provide appropriate berms, sumps, or ditches around the storage area to prevent surface water runoff from contacting the stockpiles and to prevent infiltrating water from discharging off the stockpile area as shown in the design specifications, and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP.

H. Provide a drainage system to collect accumulated liquids from all stockpiled areas and divert the liquids to an appropriate water collection andstorage system as shown in the design specifications and other requirements to be provided in the contract drawings under the direction of and as approved by the LSRP.

I. Store potentially hazardous soil separately from all other material in accordance with Hazardous Waste Regulations, N.J.A.C. 7:26G, as approved by the LSRP.

J. Collect soil samples from the stockpiles for waste characterization purposes as provided in the contract documents and as approved by the LSRP.

K. All soil and materials shall be removed from the Work Site following the Engineer's receipt and review of sampling, analysis, and characterization.

L. Confirm all analytical parameters that may be required by TSD Facilities before their acceptance of materials and as approved by the LSRP.

M. Stockpiled soil and materials classified as hazardous shall be disposed as hazardous waste in accordance with Article 1.06 herein in addition to 40 CFR 260 and as approved by the LSRP.

N. Soil classified as non-hazardous material shall be handled in accordance with Section 02112 and as approved by the LSRP.

O. In accordance with N.J.A.C. 7:9D, Well Construction and Maintenance; Sealing of Abandoned Wells, all casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute hazardous waste shall be handled in accordance with N.J.A.C. 7:26G Hazardous Waste rules.

3.06 DUST CONTROL AND MONITORING REQUIREMENTS

A. Ensure that dust generated during all Work is controlled in accordance with Federal, State, and Local regulations and as approved by the LSRP. Implement OSHA and NJDEP requirements for monitoring and control of contaminated dust, vapors and odors.

B. Conduct monitoring of worker exposures in a manner to comply with the monitoring requirements of 29 CFR 1910 and 29 CFR 1926.

C. If OSHA Permissible Exposure Limits (PELs) are exceeded, subject to the review of the Engineer and as approved by the LSRP, either engineering controls must be implemented by Contractor to reduce the contaminant levels, or PPE must be worn. If monitoring reveals elevated levels of airborne contaminants, stop Work until safe working conditions are established.

D. A perimeter air monitoring and action plan will be provided and approved by the LSRP, designed to monitor and control off-site excursion of dust, vapor and odors.

3.07 TRANSPORTATION AND FINAL DISPOSITION

A. All stockpiled material classified as hazardous (in accordance with 40 CFR 261) must be transported off-site to a permitted TSD facility in accordance with 40 CFR 264 and 40 CFR 761 within 90 days.

B. Applicable USDOT and State of New Jersey hazardous materials transporter regulations referenced herein shall be followed during the transportation and handling of all hazardous material.

C. Do not remove any excavated materials from the Work Site unless authorized by Port Authority or its agent. On the day of off-site shipment, Port Authority or its agent shall sign the hazardous waste manifest or other shipping documentation for non-hazardous materials and retain one copy.

D. Label containers used to transport hazardous material removed from the Work Site "HAZARDOUS WASTE".

E. Obtain the appropriate RCRA hazardous waste generator number from Port Authority to be provided on the waste manifest.

F. Upon delivery of the waste to the TSD Facility, the Facility representative shall sign and date the manifest/other documentation. A copy of this manifest shall be sent to Port Authority or its designated representative.

G. Provide copies of all paperwork (shipping documents) that accompany a waste shipment, including a description of the material and the on-site source, to the Engineer within two days of the shipment.

H. Provide final weight tickets and waste/shipping documents for hazardous waste from the receiving facility and transporter within seven days of shipment from the Work Site.

I. Port Authority shall receive a copy of the manifest/other documentation signed and dated by the operator of the TSD Facility within 45 days of the date the material was shipped from the Work Site.

J. Submit executed waste manifests and final Certificates of Destruction or Disposal for each load of material removed from the Work Site.

3.08 Cleaning

A. The Contractor shall design and construct a portable decontamination station to be used to decontaminate equipment and vehicles exiting from the excavation area/exclusion zone as approved by the LSRP.

B. Water generated during the decontamination process shall be characterized and disposed of in accordance with Section 02145 and as approved by the LSRP.

C. The Contractor shall comply with the remediation permit-by-rule provisions at N.J.A.C. 7:14A-7.5 for any discharges for dewatering at the site.

D. Remove all waste materials and restore all temporary storage and stockpile areas and corridors to conditions as approved by the LSRP.

E. At the completion of the Work, temporary storage and stockpile areas shall have a neat appearance and shall be graded to drain to accepted drainages to prevent erosion as approved by the LSRP. Perform grading in accordance with Section 02221.

END OF SECTION

DIVISION 2

SECTION 02110

EXCAVATION, STAGING, HANDLING, TRANSPORTATION, AND DISPOSAL OF HAZARDOUS MATERIALS FOR THE WEST FIRST STREET SITE IN BAYONNE, NEW JERSEY

APPENDIX A

SUBMITTALS

1.01 SUBMITTALS

A. Provide all submittals a minimum of 90 days before starting staging, handling, transportation and disposal work unless stated otherwise in this section.

B. At least thirty (30) days prior to the commencement of work, the Contractor's independent Environmental Consultant must submit a Soil Sampling Plan/Field Sampling Plan (SSP/FSP) for review and approval by the LSRP for the project. The plan shall include the name, address, laboratory certification status, and telephone numbers of the proposed laboratory. The plan shall also include training and experience of the personnel who will collect the samples.

1. The Contractor shall sample and analyze representative samples of the non-hazardous/contaminated/potentially hazardous soils for waste characterization. Samples shall be collected in accordance with the Material Handling Plan. Samples shall include all field/laboratory analyses that will be needed to obtain disposal facility approval. At a minimum, soils stockpiled for off-site disposal shall be sampled at a frequency of one (1) composite sample per 500 cubic yards or as required by the LSRP for the project. Each composite sample shall consist of a minimum of five (5) grab samples collected from greater than two (2) feet below the stockpile surface or as required by the LSRP for the project. The composite samples shall, at a minimum, be analyzed for Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics (Ignitability, Reactivity, Corrosivity), Full Toxicity Characteristic Leaching Procedure (TCLP) (including RCRA metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides), total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs) or as required by the LSRP for the project. Individual disposal facilities may require more extensive sampling in order to meet the requirements of their operating permits. All samples collected should be analyzed as directed by the LSRP for the project.

2. All sampling shall be conducted by a person trained in sampling protocols using standard accepted practices for obtaining representative samples. All sampling shall also be witnessed by Engineer or PA representative.

3. The Contractor must also contact the disposal facility where the waste will be sent for permanent disposal, and arrange to collect any additional samples required by the facility. The cost associated with additional sampling and testing shall be included in the bid price of this Item.

4. The quality of the data from the sampling program is the Contractor's responsibility. The Contractor must furnish all qualified personnel, equipment and instruments necessary to carry out the sampling. Unless directed otherwise by the LSRP for the project, all sampling procedures must follow the NJDEP Field Sampling Procedures Manual guidelines and protocols.

5. All sample containers shall be marked and identified with legible sample labels which shall indicate the project name, sample location and/or container, the sample number, the date and time of sampling, preservatives utilized and other information that may be useful in determining the character of the sample. Chain-of-custody shall be tracked from laboratory issuance of sample containers through laboratory receipt of the samples.

6. The Contractor shall maintain a bound sample logbook. The Contractor shall provide the PANYNJ, NJDEP and the LSRP access to it at all times and shall turn it over to the CM in good condition at the completion of the work. The following information, at a minimum, and additional information as directed by the LSRP shall be recorded in the log:

   a. Sample identification number

   b. Sample location

   c. Field observation

   d. Sample type

   e. Analyses

   f. Date/time of collection

   g. Preservation method

   h. Collector's name

   i. Sample procedures and equipment utilized

   j. Date sent to laboratory and name of laboratory

7. The Contractor shall provide a map of the stockpiles and samples indicating the location of each grab and composite sample.

8. PANYNJ reserves the right to direct the Contractor to conduct alternative sampling in lieu of the parameters described in subsection B2, if the situation warrants or as directed by the LSRP for the project. The substitute sampling parameters shall be of equal or lesser monetary value than those described in subsection B2, as determined by industry laboratory pricing standards.

9. Only dedicated or disposable sampling equipment as approved by the LSRP for the project may be used to collect these samples. All equipment involved in field sampling must be decontaminated before being brought to the sampling location, and must be properly disposed after

C. Material Handling Plan (MHP): Within forty-five (45) calendar days after award of Contract, the Contractor shall submit for review, a Material Handling Plan (MHP). The MHP must be approved by the LSRP for the project prior to the Contractor's commencement of work. The MHP shall, at a minimum, consist of:

1. It should include the training and experience of the personnel who will operate excavation and monitoring equipment.

2. The Contractor's procedures for safely handling non-hazardous contaminated soil and fill materials and hazardous soil and fill materials. The procedures must include personnel safety and health as well as environmental protection considerations. The plan shall additionally address the prevention of transporter leaks on-site (between the excavation and stockpile area).

3. Excavated soils may not be reused. The Contractor must comply with provisions under NJAC 7:26, Solid and Hazardous Waste Rules for dealing with soil management and disposal activities.

4. Name, address, NJDEP's Certified Laboratory status and telephone number of the proposed laboratory for analysis of representative soil samples. The NJDEP must approve the laboratory for the intended analysis.

5. Identification of the Contractor's proposed waste transporter(s) shall be approved by the LSRP for the project. This information shall include:

   a. Name and Waste Transporter Permit Number

   b. Address

   c. Name of responsible contact for the hauler

   d. Telephone number for the contact

   e. Any and all necessary permit authorizations for each type of waste transported

   f. Previous experience in performing the type of work specified herein

6. Identification of the Contractor's proposed disposal facilities for hazardous and non-hazardous soils (primary and back-up at minimum) for final disposal of the soils. The facilities shall be approved by the LSRP for the project. The information required for each facility shall include:

   a. Facility name and the State identification number

      (1) Facility location

      (2) Name of responsible contact for the facility

      (3) Telephone number for contact

      (4) *Signed letter of agreement to accept waste as specified in this contract*

      (5) Unit of measure utilized at facility for costing purposes

   b. A listing of all permits, licenses, letters of approval, and other authorizations to operate, which are currently held and valid for the proposed facility.

   c. A listing of all permits, licenses, letters of approval, and other authorizations to operate which have been applied for by the proposed facility but not yet granted or issued.

   d. The Contractor shall specify and describe the disposal method that the proposed facility will use to manage the waste. The Contractor shall identify the capacity available in the facility and the capacity reserved for the subject waste.

   e. The Contractor shall provide the date of the proposed facility's last compliance inspection.

f. A list of all active (unresolved) compliance orders (or agreements), enforcement notices, or notices of violations issued to the proposed facility shall be provided. The source and nature of the cause of violation shall be stated, if known.

7. Description of all sampling and field/laboratory analyses that will be needed to obtain disposal facility approval.

D. At least 30 days before any construction activities commence, submit Material Handling Plan, Waste Transportation and Off-Site Management Plan; and Pollution Prevention and Spill Contingency Plan to the Engineer. The Engineer will review the documents as approved by the LSRP for the project, and the Engineer will provide Notice to Proceed (NTP), or request revision and resubmission of these plans. Do not implement these plans until an NTP is received from the Engineer.

DIVISION 2

SECTION 02112

EXCAVATION, STAGING, HANDLING, TRANSPORTATION, AND DISPOSAL OF NON-HAZARDOUS MATERIALS FOR THE WEST FIRST STREET SITE IN BAYONNE, NEW JERSEY

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for furnishing all labor, materials, tools, and equipment, and performing all operations necessary for excavation, staging, handling, treatment, and disposal of non-hazardous and non-petroleum contaminated soil, ballast, or other materials as specified herein.

B. Work under this Section shall also include requirements for the staging, handling, transportation, and disposal of non-hazardous and non-petroleum contaminated materials and rock/construction debris materials associated with earthwork in areas that have not been previously identified, and as directed by the Engineer. The contractor shall comply with the design specifications, regulatory and other requirements to be provided in the contract drawings under the direction of and as approved by the Licensed Site Remediation Professional (LSRP) of Record for the project.

C. Related Work specified in other Sections of the Specifications includes the following:

1. Section 02110 – Excavation, Staging, Handling, Transportation, and Disposal of Hazardous Materials for the West First Street Site in Bayonne, New Jersey
2. Section 02145 - Dewatering
3. Section 02221 – Excavation, Backfilling, and Filling
4. Section 02272 – Soil Erosion and Sedimentation Control
5. Section 02895 – Disposal of Hazardous Materials

1.02 CITED STANDARDS

1. New Jersey Administrative Code (N.J.A.C.):
   a. N.J.A.C. 7:26E, Technical Requirements for Site Remediation.
   b. N.J.A.C. 7:26D, Remediation Standards.
   c. N.J.A.C. 7:26C, Administrative Requirements for the Remediation of Contaminated Sites.
   d. N.J.A.C 7:9C, Groundwater Quality Standards.
   e. Solid Waste Regulations, N.J.A.C. 7:26.

f. Hazardous Waste Regulations, N.J.A.C. 7:26G.

g. Surface Water Quality Standards, N.J.A.C. 7:9B.

2. New Jersey Uniform Construction Code (NJUCC)

3. New Jersey Department of Environmental Protection (NJDEP):

a. Guidance Document for the Remediation of Contaminated Soils, January 1998.

b. Field Sampling Procedures Manual, August 2005.

c. Soil Cleanup Criteria, May 12, 1999.

d. Guidance for the Sampling and Analysis of Concrete Designated for Recycling, June 2007.

e. Remedial Action Permits for Ground Water Guidance, February 2011

f. Remedial Action Permits for Soils Guidance, February 2011

g. Other regulatory requirements to be provided in the contract drawings as approved by the Licensed Site Remediation Professional of Record for the project.

4. Code of Federal Regulations (CFR):

a. 29 CFR 1910 – Occupational Safety and Heath Administration (OSHA).

b. 40 CFR Parts 260 and 261 (Resource Conservation and Recovery Act, RCRA)

c. 40 CFR 761, Toxic Substances Control Act (TSCA)

1.03 NOTED RESTRICTIONS

A. Do not move any non-hazardous and non-petroleum contaminated soil or other materials from their original Work Site to any other site without express written permission from the Engineer and as approved by the LSRP for the project.

B. Due to site constraints, the Contractor may be required to stockpile excavated materials off-site, or perform in-site characterization of soil and/or groundwater with written permission from the Engineer and as approved by the LSRP for the project.

1.04 QUALITY CONTROL

A. Verify soil and other material analytical results comply with applicable standards, classified in accordance with regulatory requirements to be provided in the contract drawings as approved by the LSRP for the project.

B. Verify compliance with standards and regulations including 40 CFR Parts 260 and 261 (Resource Conservation and Recovery Act, RCRA), 40 CFR 761, Toxic Substances Control Act (TSCA), N.J.A.C. 7:26 and other regulatory requirements to be provided in the contract documents and as required by the LSRP for the project.

C. Verify that sampling activities and analytical methods are in accordance with applicable regulatory protocols, referenced standards, and regulations specified herein and those to be provided in the contract drawings as required by the LSRP for the project. If at any time during the course of construction Contractor deems any soil to be contaminated other than what has been identified, immediately notify the Engineer. The Engineer will take the appropriate action to identify the soil as "contaminated". Upon determination by the Engineer and the LSRP for the project that the suspect soil is contaminated, the Engineer will authorize Contractor to handle the material as approved.

D. All off-site solid waste management methods, facilities and transporters, which Contractor intends to use to treat, dispose or transport soils and other materials shall be reviewed by the Engineer and approved by the LSRP for the project before any materials excavation under this Contract. Verify compliance with N.J.A.C 7:26 and other regulatory requirements to be provided in the contract drawings and as required by the LSRP for the project.

E. Should any problem arise regarding an approved facility or transporter that would require the return of materials to Contractor, or should such facility or transporter have violated any regulation which would result in any regulatory enforcement action, immediately notify the Engineer in writing of such situation. Make provisions for the lawful storage of the soils and other materials, at no additional expense to Port Authority, until an alternate facility or transporter can be arranged by Contractor, reviewed by the Engineer and approved by the LSRP for the project.

F. All on-site solid waste management methods that Contractor intends to use to handle or treat soils and other materials shall be reviewed by the Engineer and approved by the LSRP for the project before commencing any earthwork under this Contract.

G. Should any problem arise regarding an approved treatment method, immediately notify the Engineer in writing of such situations. Make provisions for the lawful storage of the soils and other materials, at no additional expense to Port Authority, until an alternate method, facility, and/or transporter can be arranged by Contractor, reviewed by the Engineer and approved by the LSRP for the project.

1.05 DELIVERABLES

A. Within 90 days after completion of the work, provide documentation including as a minimum, the following,

1. Photo Documentation.
2. Summary of sampling efforts and results of Laboratory analysis for all soils and materials sampled.
3. Documentation related to on-site activities including recycling, re-use and treatment, under approved Beneficial Use Determinations (BUDs).
4. Executed waste manifest or bills of lading for each load of respective material removed and transported from the Work.
5. Executed waste manifest or bills of lading signed by a responsible party of the solid waste management facility.
6. Certificates of final disposition for each manifest.

B. Provide any other documentation requested for review by the Engineer and as required by the LSRP to conform or comply with all applicable laws, codes, ordinances, and regulation.

PART 2. PRODUCTS

2.01 GENERAL

A. The Contractor shall provide, install and maintain any temporary loading facilities on site as required until completion of material handling activities. Temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles, in accordance with Section 02273 or as provided in the contract documents and required by the LSRP.

B. Containers shall be as required in the United State Department of Transportation (DOT) hazardous material/waste transport and other applicable regulations.

C. The Contractor shall assure that the waste hauler's appropriate choice of vehicles and operating practices shall prevent spillage or leakage of contaminated material from occurring en route.

PART 3. EXECUTION

3.01 PREPARATION

A. Locate, identify, and protect all utilities within the area of work from damage.

B. Protect all benchmarks, survey control points, boring locations, monitoring wells, and piezometers from damage or displacement during excavation, removal, handling, and disposal activities at the work site.

3.02 COORDINATION

A. Make requests and receive approvals for waste disposal clearances, and permits through the Engineer and Port Authority.

3.03 WORK AREA CONDITIONS

A. Representatives of NJDEP may be at the Work Site; cooperate with and give assistance to such representatives, upon review by the Engineer.

B. Contractor's Safety Supervisor/Representative shall be present at the Work Site during all Work times.

C. Display or have available at the Work Site a copy of the accepted CHSP and SWP documents.

3.04 CLEARING

A. Clear areas required for access to the Work Site and execution of the Work.

3.05 EXCAVATION, STAGING, HANDLING, TRANSPORTATION, AND DISPOSAL OF NON-HAZARDOUS, NON-PETROLEUM CONTAMINATED MATERIALS

A. Excavation activities will commence following as needed dewatering, and the materials excavated will be stockpiled onsite on plastic, with appurtenant containment to control pore water drainage. The Contractor shall comply with the remediation permit-by-rule provisions at N.J.A.C. 7:14A-7.5 for any discharges for dewatering at the site.

B. Stockpile excavated non-hazardous and non-petroleum contaminated material in designated storage area or as provided in the contract documents and required by the LSRP until waste characterization is completed.

C. Stockpiles shall be of manageable size and designed to protect the soil from precipitation, runoff, and erosion, as shown in the Contract Drawings and approved by the LSRP. Access to the area shall be restricted to authorized personnel only.

D. Storage areas shall be designed to prevent leakage from the stockpiled materials from entering surrounding soils or waters. Line and cover stockpiled areas with 4-mil thick impervious, polyethylene sheeting as shown in the Contract Drawings and approved by the LSRP.

E. Provide appropriate berms, sumps, or ditches around the storage area to prevent surface water runoff from contacting the stockpiles and to prevent infiltrating water from discharging off the stockpile area as shown in the Contract Drawings and approved by the LSRP.

F. Provide a drainage system to collect accumulated liquids from all stockpiled areas and divert the liquids to an appropriate water collection, storage, and/or treatment system as shown in the Contract Drawings and approved by the LSRP.

G. Collect samples (soils and other material) from the stockpiles for waste characterization purposes as approved by the LSRP. Proposed analytical parameters and appropriate methods are presented in Section 1.05B, these may vary and shall be performed as approved by the LSRP.

H. Confirm all analytical parameters that may be required by solid waste management facilities prior to their acceptance of material.

I. All non-hazardous and non-petroleum-contaminated soil and other materials shall be properly transported following the Engineer's receipt and written notice of sampling, analysis and characterization and as approved by the LSRP.

J. Dispositions options for non-hazardous and non-petroleum-contaminated soil and other material include:

K. Off-site disposition at an approved solid waste management facility or as approved by the LSRP.

L. No non-hazardous and non petroleum-contaminated soil shall be removed from the Work Site unless reviewed by the Construction Manager and approved by the LSRP. Transportation shall comply with N.J.A.C. 7:26 and other requirements identified in the contract documents and approved by the LSRP. On the day of off-site shipment, with approval of the LSRP, the Engineer shall sign the waste manifest or bill of lading and retain one copy.

M. All vehicles used to transport material to off-site facilities shall be covered to prevent loss soil during transport to the disposal facility.

N. Vehicles shall utilize maximum legal load limits for transport from the Work Site to the disposal facility.

O. Disposition of contaminated material at an off-site facility shall include all time incurred for queuing, weighting and tipping at the facility.

P. Deliver all scale tickets to the Engineer for confirmation of quantities.

Q. Submit executed waste manifests and/or bill-of-lading for each load material removed from the Work Site.

R. Contractor to provide copies of all paperwork (shipping documents) that accompany a waste shipment, including a description of the material and the on-site source, to the Engineer within two days of the shipment.

S. Provide final weight tickets and waste/shipping documents form the receiving facility and transporter within seven days of shipment from the Work Site.

3.06 HANDLING OF NON-CONTAMINATED MATERIALS

A. Stockpiling and pre-classification is not required of material classified as non-contaminated and approved by the LSRP.

B. If off-site transportation and disposal of non-hazardous, non-petroleum impacted material is necessary due to construction and spatial considerations, then the material shall be stockpiled, sampled, and characterized before disposal. Transportation shall comply with N.J.A.C. 7:26 and Federal regulations, as approved by the LSRP.

C. Stockpiles shall be of manageable size and designed to protect the soil from precipitation, runoff and erosion, as shown in the Contract Drawings and approved by the LSRP. Access to the area shall be restricted to authorized personnel only.

D. Storage areas shall be designed to prevent leakage from the stockpiled materials from entering surrounding surface soils or waters. Line and cover stockpiled areas with 4-mil thick impervious, polyethylene sheeting.

E. Provide appropriate berms, sumps, or ditches around the storage area to prevent surface water runoff from contacting the stockpiles and to prevent infiltrating water from discharging off the stockpile area.

F. Provide a drainage system to collect accumulated liquids from all stockpiled areas and divert the liquids to an appropriate water collection, storage, and/or treatment system.

G. Confirm all analytical parameters that may be required by disposal or treatment facilities before their acceptance of materials. No extra payment shall be made for additional sampling and analysis for waste characterization purposes.

H. Additional analytical parameters may be required by disposal facilities before their acceptance of materials.

I. Contractor to provide copies of all paperwork (shipping documents) that accompany a waste shipment, including a description of the material and the on-site source, to the Engineer within 2 days of the shipment.

J. Provide final weight tickets and waste/shipping documents from the receiving facility and transporter within 7 days of shipment from the Work Site.

K. In accordance with N.J.A.C. 7:9D, Well Construction and Maintenance; Sealing of Abandoned Wells, all casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute non-hazardous waste (e.g., construction and demolition 13C waste) shall be handled in accordance with N.J.A.C. 7:26-2.1. This would include waste material resulting from construction and demolition operations, e.g., wood scrap; tree parts/stumps and brush; concrete, asphalt, masonry; building materials; ferrous and nonferrous metal; non-asbestos building insulation; plastic scrap; dirt; and other miscellaneous materials; not including other solid waste types as classified by NJDEP.

3.07 DUST CONTROL AND MONITORING REQUIREMENTS

A. Ensure that dust generated during all Work is controlled in accordance with Federal, State, and Local regulations and as approved by the LSRP. Implement OSHA and NJDEP requirements for monitoring and control of contaminated dust, vapors and odors.

B. Conduct monitoring of worker exposures in a manner to comply with the monitoring requirements of 29 CFR 1910 and 29 CFR 1926.

C. If OSHA Permissible Exposure Limits (PELs) are exceeded, subject to the review of the Engineer and as approved by the LSRP, either engineering controls must be implemented by Contractor to reduce the contaminant levels, or PPE must be worn. If monitoring reveals elevated levels of airborne contaminants, stop Work until safe working conditions are established.

D. A perimeter air monitoring and action plan will be included in the remedial action work plan, as approved by the LSRP, designed to monitor and control off-site excursion of dust, vapor and odors.

3.08 CLEANING

A. The Contractor shall design and construct a portable decontamination station to be used to decontaminate equipment and vehicles exiting from the excavation area/exclusion zone as approved by the LSRP.

B. Water generated during the decontamination process shall be characterized and disposed of in accordance with Section 02145 and as approved by the LSRP.

C. The Contractor shall comply with the remediation general permit provisions at N.J.A.C. 7:14A-7.5 for any discharges related to dewatering at the site.

D. Remove all waste materials and restore all temporary storage and stockpile areas and corridors to conditions as approved by the LSRP.

E. At the completion of the Work, temporary storage and stockpile areas shall have a neat appearance and shall be graded to drain to accepted drainages to prevent erosion as approved by the LSRP. Perform grading in accordance with Section 02221.

END OF SECTION

DIVISION 2

SECTION 02112

EXCAVATION, STAGING, HANDLING, TRANSPORTATION, AND DISPOSAL OF NON-HAZARDOUS MATERIALS FOR THE WEST FIRST STREET SITE IN BAYONNE, NEW JERSEY

APPENDIX A

SUBMITTALS

1.01 SUBMITTALS

A. Provide all submittals a minimum of 90 days prior to the start of an activity unless stated otherwise in this Section.

B. At least thirty (30) days prior to the commencement of work, the Contractor's independent Environmental Consultant must submit a Soil Sampling Plan/Field Sampling Plan (SSP/FSP) for review and approval by the LSRP for the project. The plan shall include the name, address, laboratory certification status, and telephone numbers of the proposed laboratory. The plan shall also include training and experience of the personnel who will collect the samples.

1. The Contractor shall sample and analyze representative samples of the non-hazardous/contaminated/potentially hazardous soils. Samples shall be collected in accordance with the Material Handling Plan. Samples shall include all field/laboratory analyses that will be needed to obtain disposal facility approval. The soils stockpiled for off-site disposal shall be sampled at a frequency of one (1) composite sample per 500 cubic yards or as required by the LSRP for the project. Each composite sample shall consist of a minimum of five (5) grab samples collected from greater than two (2) feet below the stockpile surface or as required by the LSRP for the project. The composite samples shall, at a minimum, be analyzed for Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics (Ignitability, Reactivity, Corrosivity), Full Toxicity Characteristic Leaching Procedure (TCLP) (including RCRA metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides), total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs) or as required by the LSRP for the project. Individual disposal facilities may require more extensive sampling in order to meet the requirements of their operating permits. All samples collected should be analyzed as directed by the LSRP for the project.

2. All sampling shall be conducted by a person trained in sampling protocols using standard accepted practices for obtaining representative samples.

3. The Contractor must also contact the disposal facility where the waste will be sent for permanent disposal, and arrange to collect any additional samples required by the facility. The cost associated with additional sampling and testing shall be included in the bid price of this Item.

4. The quality of the data from the sampling program is the Contractor's responsibility. The Contractor must furnish all qualified personnel, equipment and instruments necessary to carry out the sampling. Unless directed otherwise by the LSRP for the project, all sampling procedures must follow the NJDEP Field Sampling Procedures Manual guidelines and protocols.

5. All sample containers shall be marked and identified with legible sample labels which shall indicate the project name, sample location and/or container, the sample number, the date and time of sampling, preservatives utilized and other information that may be useful in determining the character of the sample. Chain-of-custody shall be tracked from laboratory issuance of sample containers through laboratory receipt of the samples.

6. The Contractor shall maintain a bound sample logbook. The Contractor shall provide the PANYNJ, NJDEP and the LSRP access to it at all times and shall turn it over to the Engineer in good condition at the completion of the work. The following information, at a minimum, and additional information as directed by the LSRP for the project shall be recorded in the log:

   a. Sample identification number

   b. Sample location

   c. Field observation

   d. Sample type

   e. Analyses

   f. Date/time of collection

   g. Preservation method

   h. Collector's name

   i. Sample procedures and equipment utilized

   j. Date sent to laboratory and name of laboratory

7. The Contractor shall provide a map of the stockpiles and samples indicating the location of each grab and composite sample.

8. PANYNJ reserves the right to direct the Contractor to conduct alternative sampling in lieu of the parameters described in subsection B2, if the situation warrants or as directed by the LSRP for the project.

9. Only dedicated or disposable sampling equipment, as approved by the LSRP for the project, may be used to collect these samples. All equipment involved in field sampling must be decontaminated before being brought to the sampling location, and must be properly disposed after.

C. Material Handling Plan (MHP): Within forty-five (45) calendar days after award of Contract, the Contractor shall submit for review, a Material Handling Plan (MHP). The MHP must be approved by the LSRP for the project prior to the Contractor's commencement of work. The MHP shall, at a minimum, consist of:

1. The Contractor's procedures to allow visual identification of non-hazardous waste and hazardous waste during excavation. It should include the training and experience of the personnel who will operate excavation and monitoring equipment.

2. The Contractor's procedures for safely handling non-hazardous contaminated soil and fill materials and hazardous soil and fill materials. The procedures must include personnel safety and health as well as environmental protection considerations. The plan shall additionally address the prevention of transporter leaks on-site (between the excavation and stockpile area).

3. Excavated soils may not be reused. The Contractor must comply with provisions under NJAC 7:26, Solid and Hazardous Waste Rules for dealing with soil management and disposal activities.

4. Name, address, NJDEP's Certified Laboratory status and telephone number of the proposed laboratory for analysis of representative soil samples. The NJDEP and LSRP must approve the laboratory for the intended analysis.

5. Identification of the Contractor's proposed waste transporter(s) approved by the LSRP for the project. This information shall include:

   a. Name and Waste Transporter Permit Number

   b. Address

   c. Name of responsible contact for the hauler

   d. Telephone number for the contact

   e. Any and all necessary permit authorizations for each type of waste transported

   f. Previous experience in performing the type of work specified herein

6. Identification of the Contractor's proposed disposal facilities for hazardous and non-hazardous soils (primary and back-up at minimum) for final disposal of the soils. The facilities shall be approved by the LSRP for the project. The information required for each facility shall include:

   a. Facility name and the State identification number

      (1) Facility location

      (2) Name of responsible contact for the facility

      (3) Telephone number for contact

      (4) Signed letter of agreement to accept waste as specified in this contract

      (5) Unit of measure utilized at facility for costing purposes

   b. A listing of all permits, licenses, letters of approval, and other authorizations to operate, which are currently held and valid for the proposed facility.

   c. A listing of all permits, licenses, letters of approval, and other authorizations to operate which have been applied for by the proposed facility but not yet granted or issued.

   d. The Contractor shall specify and describe the disposal method that the proposed facility will use to manage the waste. The Contractor shall identify the capacity available in the facility and the capacity reserved for the subject waste.

   e. The Contractor shall provide the date of the proposed facility's last compliance inspection.

f. A list of all active (unresolved) compliance orders (or agreements), enforcement notices, or notices of violations issued to the proposed facility shall be provided. The source and nature of the cause of violation shall be stated, if known.

7. Description of all sampling and field/laboratory analyses that will be needed to obtain disposal facility approval.

D. Evidence of current valid permits, licenses, and certifications including, as a minimum, the following:

1. Off-site transportation entity permits and licenses including a copy of the Spill Prevention and Contaminant Containment (SPCC) Plan.

2. Written verification by a Certified Industrial Hygienist (CIH) of approval of Contractor's Site-Specific Construction Health and Safety Plan (CHSP) and Safe Work Plan (SWP) documents and a copy of the reports.

3. Name, location, telephone number, and all required permits of all handling facilities.

E. At least 30 days before any construction activities commence, submit material handling plan, waste transportation and off-site management plan; and pollution prevention and spill contingency plan to the Engineer. The Engineer will review; the documents approved by the LSRP for the project and the Engineer will provide Notice to Proceed (NTP), or request revision and resubmission of these plans. Do not implement these plans until an NTP is received from the Engineer.

DIVISION 2

SECTION 02145

DEWATERING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for dewatering construction excavations.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. The Contractor shall take all steps necessary to familiarize with and obtain a thorough knowledge of the characteristics of the existing soils, groundwater and site conditions adjacent to and beneath the Work area prior to designing and selecting a dewatering system.
2. The Contractor shall be responsible for verification of location of existing underground structures and utilities.
3. Dewatering system shall not interfere with existing structures, utilities or with the construction.
4. Dewatering shall be conducted from inside the enclosure formed by the excavation support system. External dewatering will not be permitted. The groundwater drawdown outside of the excavation support system shall be minimized and shall satisfy the requirements shown on the Contract Drawings.

B. Dewatering System

1. The dewatering system shall be capable of lowering and controlling the ground water level and hydrostatic pressure to permit the excavation and other Work to be performed in the dry, to preclude disturbance to soil at or below foundation sub-grade and to prevent uplift of the construction due to hydrostatic pressure.
2. Maintain adequate control so that: the stability of excavated and construction slopes is not adversely affected by storm water or runoff; erosion is controlled; and flooding of excavations or damage to structures does not occur. The control of all ice and snow shall be considered as part of the dewatering requirements.
3. Where excavations extend below the water table, lower the water table and hydrostatic head to a minimum of two feet below the elevation of the required sub-grade and maintain this condition during construction.
4. To monitor effectiveness of dewatering system install instrumentation as detailed on Contract Drawings and in conformance with the Section of these Specifications entitled "GEOTECHNICAL INSTRUMENTATION AND MONITORING".

1.03 QUALITY ASSURANCE

A. Entities performing the Work of this Section shall have been engaged in such Work for at least the last five years, shall have satisfactorily completed at least three dewatering projects involving complexities similar to those required under this Contract and shall have available adequate equipment, facilities and qualified personnel to design, install and maintain the dewatering system required under this Section.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

(Not Applicable)

PART 3. EXECUTION

3.01 INSTALLATION

A. Installation of dewatering system shall not commence until approval of the design and equipment has been received in writing from the Engineer. Approval by the Engineer shall not relieve the Contractor from responsibility for the adequacy of the design to achieve the performance requirements, as specified in 1.02 of this Section.

B. The Engineer will establish average piezometric levels from the measurements of groundwater levels in piezometers installed by the Contractor prior to the dewatering operations. The piezometer readings observed during construction shall be referenced to the pertinent preconstruction groundwater level to determine the extent of ground water lowering.

C. Intercept and divert storm water runoff, surface water, and groundwater away from excavation and piezometer installations through the use of dikes, curb walls, ditches, pipes, sumps or other means.

D. Dewatering operations shall be designed to prevent loss of fines through the well points and pumping system.

E. Elements of the system shall be located so as to allow for a continuous dewatering operation without interfering with the permanent construction. Where portions of the dewatering system are located in the areas of permanent construction, the Contractor shall submit details of the method he proposes for installing the permanent construction in these locations for the approval of the Engineer.

3.02 OPERATIONS

A. Prior to commencing dewatering operations, install and obtain initial readings on all instrumentation specified in the Section of these specifications entitled "GEOTECHNICAL INSTRUMENTATION AND MONITORING". Do not commence pumping until installation records and initial readings have been received and approved by the Engineer.

B. The dewatering system shall be activated sufficiently in advance of excavation, so that the water level is maintained below the surface of the excavation during all stages of construction.

C. Unless otherwise approved by the Engineer, the dewatering system shall be operated on a twenty-four hour per day basis, seven days per week, and standby pumping facilities shall be provided to maintain the continued effectiveness of the system. Dewatering operations shall not be discontinued without the prior written approval of the Engineer.

D. Maintain the water level within the limit of excavation a minimum of two feet below the sub-grade, unless otherwise permitted by the Engineer. Maintain the water level at said elevation until no danger to any structure under construction can occur because of buildup of excessive hydrostatic pressure.

E. If approved by the Engineer, the extent of dewatering may be reduced for structures designed to withstand uplift pressure, provided the water level at any stage of the construction does not result in uplift pressures in excess of 80 percent of the downward pressure produced by the weight of the structure and backfill (if any) in place.

F. If groundwater is encountered within the excavation at higher elevations than are observed in the piezometers, it shall be lowered to meet the requirements of this Section.

G. If, in the opinion of the Engineer, the water levels are not being lowered or maintained as required by this Section, install additional or alternate dewatering equipment as necessary, at no additional cost to the Authority.

H. Put standby equipment in immediate operation in the event that any part of the system becomes inadequate or fails.

3.03 WATER DISPOSAL

A. Dispose of water per specifications provided in Section 02110, 02112, 02892 and 02894, and in accordance with applicable regulations and guidance.

B. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of Work under construction or completed. Dispose of water in a manner to avoid inconvenience to others engaged in Work about the construction site. Provide sumps, silt boxes and other flow control devices as required.

3.04 GROUNDWATER DEWATERING DISCHARGE IN NEW JERSEY

A. Determine if effluent is contaminated (exceeding surface water quality standards) and as approved by the LSRP prior to any discharge.

B. Discharge all effluent containing uncontaminated water to a catch basin approved by the engineer and the LSRP. Effluent shall not be discharged through wetlands, pavement or other adjacent areas and shall not cause flooding or ponding on site or in adjacent areas.

C. When discharging uncontaminated water to storm sewer or surface water: comply with the requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) General Dewatering Construction (B7) Permit (NJPDES Permit No. NJ0134511) and as approved by the LSRP.

D. When discharging contaminated water to storm sewer or surface water: comply with the requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) General Groundwater Remediation Clean-Up (BGR) General Permit (NJPDES Permit No. NJ 0155438) and as approved by the LSRP.

E. In all cases, the contractor shall be the entity authorizing and responsible for the work that results in a discharge authorized by a permit. Submit copies of all submittals required by the permit to the engineer. Dewatering discharge shall not exceed the pollutant limits set in the construction dewatering discharges or groundwater remediation clean-up general permit, as applicable.

1. Sample initial dewatering discharge for the required parameters in the groundwater remediation clean-up general permit.

2. Do not discharge to storm sewer or surface water until demonstrated to the engineer that the discharge does not exceed applicable pollutant limits.

F. In absence of permit, all contaminated effluent is to be collected and stored to be analyzed for waste characterization sampling and analysis and as approved by the LSRP prior to disposal as either hazardous or non-hazardous waste.

G. Ensure that the total rated capacity for all on-line dewatering pumps shall not exceed 100,000 gallons per day.

3.05 GROUNDWATER DEWATERING DISCHARGE IN NEW YORK

A. Discharge all effluent to a catch basin approved by the engineer. The contractor may submit for approval an alternate plan to recharge dewatering effluent on site to groundwater through infiltration trenches, injection wells, or other appropriate methods. Effluent shall not be discharged through wetlands, pavement or other adjacent areas and shall not cause flooding or ponding on site or in adjacent areas.

B. When discharging to storm sewer or surface water the discharge shall not contain any scum, foam or other residual matter, the discharge shall not exhibit a visible sheen, the discharger shall minimize the amount of suspended solids or turbidity in the discharge, there shall be no discharge of floating solids in other than trace amounts.

C. Submit to the Engineer a groundwater dewatering discharge plan. The plan shall include best management practices to minimize pollutants as required in 3.05B of this Section.

D. If effluent from dewatering operations exhibits evidence of petroleum contamination such as sheen, liquid-phase product, odor, or floatables, the contractor shall cease dewatering operations and proceed as directed by the Engineer.

E. Dewater the excavation using either sumps or well points. The excavation shall be dewatered to the limits of excavation and no greater.

F. Take all appropriate steps to assure that dewatering does not result in settling that shall cause damage to adjacent structures. These measures shall be described in the dewatering plan.

G. The contractor shall ensure all necessary precautions are taken to preclude contamination of any wetland or waterway by suspended solids, sediments, fuels, solvents, lubricants, epoxy coatings, paints, concrete, leachate or any other environmentally deleterious materials associated with the project.

H. Best management practices must be employed to prevent the loss of construction materials, debris and sediments from entering the wetlands or waterways. Such practices may include but are not limited to, construction fencing, staked hay bales, filter fabric and silt fencing.

3.06 REPAIR AND CLEAN-UP

A. After dewatering is completed, after completion of the permanent construction, or as approved by the Engineer, dismantle and remove all equipment.

B. Promptly repair and/or replace all damaged or destroyed facilities to the satisfaction of the Engineer.

C. All patching shall be performed in accordance with the requirements of the Specifications entitled "CUTTING, PATCHING AND REMOVAL".

END OF SECTION

SECTION 02145

DEWATERING

APPENDIX A

SUBMITTALS

A. *Summary of Qualifications*

1. Submit summary of qualifications and experience on projects of similar complexity to demonstrate conformance to the requirements of 1.03 of this Section.
2. Submit details of method proposed for installing the permanent construction in areas where dewatering is required.
3. Submit design calculations for the extent of ground water lowering and pumping discharge. Methods of calculation shall be subject to approval by the Engineer.
4. Submit shop drawings in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS, showing the layout of all appurtenances for the dewatering system including pump sizes(s), sumps, filters, wellpoint size and spacing, header pipe size, discharge pipe size, silt box size and construction, discharge locations and any other equipment required by the Work. The drawings shall be drawn to a scale of 1 inch equals 20 feet.
5. Submit daily reports recording discharge flow rate from the dewatering system.
6. All changes to the Contractor's approved dewatering systems shall be subject to the approval of the Engineer.

B. Contract Drawings

Ensure that the Contract Drawings show the following items specified in the text:

1. Place note if limitation on maximum extent of dewatering is required to control settlements of adjacent structures, or for other reasons.
2. Show locations for discharge of pumped water, if locations are known or required.

END OF APPENDIX A

DIVISION 2

SECTION 02160

MANUFACTURED TREATMENT DEVICES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirement for precast manufactured stormwater treatment systems.

B. Definition of terms shall be in accordance with ASTM C822.

1.02 SYSTEM DESCRIPTION

1.03 REFERENCES

A. The following is a list of the publications referenced in the Section:

American Association of State Highway and Transportation Officials

AASHTO M105	Gray Iron Castings

American Society of Testing and Materials (ASTM) International

ASTM A48	*Standard Specifications for Gray Iron Castings*
ASTM B209	Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C150	Specification for Portland Cement
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C595M	Standard Specification for Blended Hydraulic Cements
ASTM C822	Terminology Relating to Concrete Pipe and Related Products
ASTM C857	Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures
ASTM C990-91	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Each stormwater treatment system shall have treatment, sediment storage and oil storage capacities equal to or greater than shown on the contract plans. For the purpose of determining equivalency, the treatment capacity shall be defined as the flow rate at which the stormwater treatment system removes 80% of an underground silica sample having an average particle size equal to or less than 240 microns. Treatment capacity shall be additional defined as the maximum flow rate prior to which bypass of any flow occurs.

B. Design of lifting devices for precast structures shall conform to ASTM C 913.

C. Each stormwater treatment system shall be certified by NJDEP to provide 50% Total Suspended Solids (TSS) removal efficiency.

D. Each stormwater treatment system shall include a circular chamber with a tangential inlet to induce a swirling flow pattern within the treatment chamber. The outlet from the treatment chamber shall be located in the center of the chamber so as to maximize the particle flow path within the treatment system.

E. Each stormwater treatment system shall be designed to not allow surcharge of the upstream piping network during dry weather conditions.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Cold and hot weather requirements shall conform to the applicable requirements of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" except that in a precast plant the ambient temperature may be below 40 degrees F providing that forms and product are preheated and heat cured and protected. Temperature recording devices shall be used.

1.06 QUALITY ASSURANCE

A. Workmen shall be experienced and skilled in the fabrication and installation of precast and/or cast-in-place stormwater treatment systems.

B. Stormwater treatment systems shall be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no additional cost to the Authority.

C. Stormwater treatment systems may be inspected by the Engineer at the place of manufacture.

D. Tolerances of dimensions, squareness, joint surfaces, reinforcement location and thickness of slabs and walls for precast structures shall conform to ASTM C913.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with stormwater treatment system manufacturer's instructions for unloading, storing and moving precast structures.

B. Care shall be taken when storing stormwater treatment systems to prevent damage to Authority or other public or private property, any damage caused by the unloading, storage or moving stormwater treatment systems shall be repaired at no additional cost to the Authority.

C. Each stormwater treatment system shall be clearly marked by indentation or waterproof paint to indicate the date of manufacture, manufacturer and identifying symbol and/ or number to indicate its intended use.

1.08 GUARANTEES

1.09 MAINENANCE

1.10 SUBMITTALS

A. SEE Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURER

A. For each of the specified materials, manufacturer shall be one of the following, or approved equal: Stormwater treatment systems shall be as shown on the contract drawings.

2.02 MATERIALS

A. Concrete

1. Concrete for precast stormwater treatment systems shall conform to ASTM C857 and C478. Cement shall be Type I, II or III Portland cement conforming to ASTM C150. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20-44 (MS18) loading requirements as determined by a Licensed Professional Engineer. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has obtained a compressive strength of 4,000 psi or other designated suitable handling strength.

B. Joints

1. Sections shall have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C990.

C. Internal Components

1. All internal components shall be PVC per ASTM D1785, and aluminum alloy 5052-H32 plate in accordance with ASTM B209.

2. A bitumen sealant in conformance with ASTM C990 shall be utilized in affixing the aluminum bays to the concrete vault.

D. Brick or Masonry

1. Brick or masonry used to build the manhole frame to grade shall conform to ASTM C32 or ASTM C139 and shall be installed in accordance with Section 02721.

E. Frames, Grates and Covers

1. Castings for manholes, frames and covers shall be in accordance with ASTM A48, CL. 35B and AASHTO M105. The manhole frame and cover shall be equivalent to Campbell Foundry Pattern #1009A.

F. Crushed Stone Bedding

1. Crushed limestone, gneiss, trap rock or recycled Portland cement aggregate conforming to ASTM C33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of Section 02231 entitled "AGGREGATE BASE COURSE".

G. Connection between Structure and Pipe

1. Pipe openings shall be sized to accept pipes of the specified size (s) and materials (s), and shall be sealed by the Contractor with a hydraulic cement conforming to ASTM C595M.

2.03 CONSTRUCTION FEATURES

2.04 ACCESSORIES

2.05 FABRICATION / or MIXES

A. Manufacture of precast stormwater treatment systems shall conform to ASTM C913.

2.06 SHOP FINISHING

2.07 SHOP TESTING

PART 3. EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

A. Ensure proper orientation of the structure to accommodate pipes.

B. Immediately prior to placement in the excavation, the precast stormwater treatment systems shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be removed for the construction site and replaced, at no additional cost to the Authority. Subject to the approval of the Engineer, damaged units may be repaired in a manner that ensures that the structure shall conform to the requirements of this Section and its intended use. Acceptance of repaired units is at the sole discretion of the Engineer.

3.03 INSTALLATION

A. Excavation and Backfill

1. Excavate for stormwater treatments systems in accordance with SECTION 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Contract Drawings. Provide clearance around the sidewalls of the structure as required for construction.

2. If groundwater is encountered, prevent accumulation of water in excavations by methods approved by the engineer. Stormwater treatment systems shall be placed in a dry trench.

3. Where the possibility exists of a water tight structure becoming buoyant in a flooded excavation, take necessary steps to avoid flotation of the structure.

B. Support and Backfilling

1. Stormwater treatment systems shall be supported at proper grade and alignment on a 6-inch (minimum thickness) crushed stone bedding or other support system as shown on the Contract Drawings.
2. Backfill excavation for the stormwater treatment system in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

C. Installation of Precast Concrete Structure

1. To ensure safety, the stormwater treatment system shall be lifted only at the lifting points so designed by the Engineer.
2. When lowering the stormwater treatment system into the excavation and joining pipe to the structure, take precautions to ensure that the pipes and structure remain clean.
3. Set precast stormwater treatment system so that it is fully bearing on crushed stone bedding compacted in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" or set on another support system as shown on the Contract Drawings.
4. For multiple section structures, lower and set the base section before placing additional sections. Ensure joint integrity by removing all foreign material from joint surfaces and verify the sealing materials are place properly. Avoid misalignments by using guide devices affixed to the lower section or as otherwise recommended by the manufacturer.
5. Verify that stormwater treatment systems installed satisfy required alignment and grade.
6. Remove knockout or core the structure for pipe so as not to create an opening in excess of that required. Fill resultant annular space with mortar cement in accordance with manufacturer's recommendations.
7. Cut pipe to finish flush with interior of the stormwater treatment systems.

D. Installation of Frame and Cover or Grate

1. Set frame using mortar and masonry as shown on the Contract Drawings. Radially laid brick shall have ¼-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar cement and completely fill all joints. When more than one course of concrete brick is requires, stagger vertical joints.
2. Set frame and cover two inches above finished grade for manhole structure located in unpaved areas. Otherwise, set frame and cover flush with finished grade.
3. Manhole frames and covers shall be fitted together and match-marked to avoid rocking of covers and grates. All castings shall be set firm and snug and shall no rattle.

3.04 FIELD QUALITY CONTROL

3.05 ADJUSTING

3.06 PROTECTING

A. Protection and curing of concrete shall be is accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

END OF SECTION

SECTION 02160

MANUFACTURED TREATMENT DEVICES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirement of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

A. Shop Drawings
   1. Shop drawings of precast stormwater treatment system.

B. Catalog Cuts
   1. Catalog cuts of frame, grate and covers.
   2. Catalog cuts of gaskets for joints in precast stormwater treatment system, including manufacturer's installation instructions.

C. Submit design calculations prepared by a professional Engineer, licensed in the State where the work is being performed:
   1. For designs of substitute stormwater treatment systems. Calculations shall demonstrate that the substituted design is equivalent to the design shown on the Contract Drawings.

D. Submit certificate from gasket manufacturer certifying that the gaskets comply with the specified requirements and that the gaskets are compatible with the type of joint used.

E. Submit plans, methods, equipment and procedures applicable for:
   1. Prevention of accumulation of groundwater as specified in 3.02.
   2. Methods other than guide devices to avoid misalignment of joints during installation of precast concrete structures as specified in 3.02
   3. methods to prevent flotation of watertight structures as specified in 3.02

F. Submit to the Chief of Materials Engineering, materials Engineering, Port Authority Technical Center, 241 Erie Street, jersey City, New Jersey 07320-1397, certified test data covering the gradation and composition of the crushed stone for bedding proposed for use.
   1. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

END OF APPENDIX 'A"

DIVISION 2

SECTION 02212

GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for geotechnical and structural instrumentation and monitoring.

B. Requirements for furnishing, installing, and maintaining geotechnical and structural instruments (for surface, in-ground, and existing structures); carrying instrumentation designs to the 100-percent level where they are only conceptualized or not fully complete in the Contract Drawings; protecting instrumentation from damage; removing instruments unless otherwise specified, and collecting and interpreting monitoring data. It also includes additional instrumentation and data collection that Contractor deems necessary to ensure the safety of personnel and the Work. Implement required remedial and precautionary measures based on the instrumentation data.

C. Definitions

1. "Acceptance Reading": Post-installation reading performed for each completed instrument by Contractor and submitted to the Engineer for review.
2. "Alert System": Automatically generate Alerts to immediately notify the Engineer when Threshold and Limiting Response Values defined herein are reached or exceeded as determined by a sensor or monitoring point readings and/or by the data management system.
3. "Central Data Management" (CDM) System: A computerized system encompassing a database server and a web server set up and maintained by Contractor to process, store and distribute geotechnical instrumentation data via a limited access website.
4. "Datalogger": Data collection unit to collect, pre-evaluate, and transfer data readings from various instruments. The datalogger transfers these data to intermediate data storage (IDS) unit via direct connection (short-haul modem) or telephone modem.
5. "Facility": An existing building, roadway, element of a utility system, or structure other than the new or related ancillary structure to be built under this Contract.
6. "Formal Initial Reading": The reading that is closest to the average of three consistent readings taken by Contractor soon after instrument installation and accepted by the Engineer as being the one with which all subsequent readings will be compared to determine level of change.
7. "Baseline Readings": Readings taken over a long period of time (months) before start of any construction that define movements that are related to seasonal and climate changes.
8. "Geotechnical Instrument": A term that includes instruments installed on buildings and other facilities (structural instrumentation) as well as those installed in and on the ground.

9. "Intermediate Data Storage (IDS) Unit": Data storage unit furnished by Contractor that receives data from data loggers and transfers it to the CDM via telephone modem

10. "Limiting Value": The second and greater instrument reading that could cause stoppage to the construction and necessitates mitigative action to halt movements or vibrations and avoid damage to existing structures. The action must be such as to ensure the Limiting Value is not exceeded in subsequent construction.

11. "Response Values": Comprised of "Threshold Values" and "Limiting Values"

12. "Threshold Value": The first and lowest instrument reading that will trigger the implementation of mitigative action to avoid damage to existing structures.

13. "Construction": Construction activities including excavating of more than 5 feet below existing grades, lowering of ground water table by more than 1 feet, installation of earth support of excavation walls, installation of anchors, bracing, ground improvement, demolition of piers and structure elements, backfilling for retaining walls, concrete placement, drilled shafts, pile and sheet pile installation, temporary tower and steel erections, and any other work that may affect the instrumentation as determined by the Engineer.

D. Purposes of the Geotechnical Instrumentation Program include but are not limited to providing:

1. Pre-construction baseline data for comparison with construction and post-construction data.

2. Monitoring of movements of ground, groundwater level, and facilities during and after construction, to determine whether they have been affected by construction activities.

3. A forewarning of unforeseen conditions and trigger actions required when "Threshold Values" and/or "Limiting Values" have been reached.

E. The Authority is not responsible for the safety of the Work based on geotechnical or structural instrumentation data.

F. Responsibilities of Contractor

1. Furnish components of instrumentation that are to be installed during construction as specified herein.

2. Furnish all portable readout units for all instrumentation as specified herein.

3. Install instruments and the automated data acquisition systems including data loggers and IDS's required to monitor them. Configure the automated data acquisition systems to monitor the instruments on the schedules indicated herein.

4. Protect from damage and maintain instruments installed by Contractor and existing instrumentation installed by others. Repair or replace damaged or inoperative instruments.

5. Monitor instruments, and interpret data from instrumentation specified herein, and collect and interpret additional data from instrumentation specified herein to the degree that Contractor deems necessary to ensure the safety of personnel and the Work.

6. Carry out Acceptance Readings after installation of each instrument as soon as practicable, as soon as any encasing grout has reached its final set.

7. Provide to the Engineer safe access to any part of the work for inspection to confirm adequacy of Contractor's installations and monitoring procedures.

8. Implement response actions.

9. In addition to inspections carried out by the Engineer, visually inspect utilities and structures before and after construction operations that might affect their integrity when Contractor believes it may be required to ensure the safety of personnel and the work, at no additional cost to the Authority.

10. The instrumentation and monitoring Contract Drawings show conceptual layout of some automated motorized total station (AMTS) systems. Upon inspection of the facilities to be instrumented, finalize the layout and design, and develop details of support and installation, including determination of the number of and locations of required AMTS theodolites and reference prisms. Submit the detailed design along with conduits, cables, and power and communication requirements to the Engineer for review. The Engineer will provide necessary input to Contractor for finalization of the design and installation details.

11. Coordinate with the Engineer to engage the proper authorities in arranging telephone lines for modems and electrical power for data loggers and intermediate data storage units. In addition, ensure continuous back-up electrical power (batteries, etc.) in case of failure of the primary systems. This shall in no way relieve Contractor of its obligation to pay for power and telephone lines as specified elsewhere.

12. Contractor shall be responsible for cable installations, telephone installations, and telephone charges.

13. Furnish a functioning Central Data Management (CDM) system capable of reducing and recording all geotechnical instrumentation data produced by the Project dataloggers and data resulting from manual readings collected from instruments not connected to a datalogger. The system shall be able to automatically issue electronic Alerts/notices by e-mail, pager, and telephone whenever a Response Value is reached. The system shall be capable of permitting adjustments to the monitoring frequencies and notice levels.

14. Monitor geotechnical instruments, interpret the data and place reduced data on a limited access website for viewing and printing reports by the Engineer and selected other users.

15. Provide on-site training for the Engineer and selected other users on the viewing and printing of reports from the CDM system website.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM International)

ASTM	*Standard Specification for:*
ASTM C150	Portland Cement
ASTM C778	Standard Sand
ASTM	*Standard Test Method for:*
ASTM C109	Compressive Strength of Hydraulic Cement Mortars(Using 2-in. or [50-mm] Cube Specimens)
ASTM D1586	Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM	*Standard Practice for:*
ATSM D2113	Rock Core Drilling and Sampling of Rock for Site Investigation

ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)

Deutsches Institut für Normung (DIN)

DIN 18723	Field Procedure for Precision Testing of Surveying Instruments

National Geodetic Survey (NGS)

National Institute of Standards and Technology (NIST)

1.03 RELATED SECTIONS

A. Section 02100 - Permanent Survey Markers

B. Section 02145 - Dewatering

C. Section 02376 - Micro-Piles

D. Section 02378 - Drilled Shafts

E. Section 02892 – Handling, Treatment and Disposal of Soil Materials (New Jersey)

F. Section 02894 – Handling, Treatment and Disposal of Non-Hazardous Soil Materials (New York)

G. Section 02895 –Disposal of Hazardous Material

H. Section 02897 – Contaminated Materials Management

1.04 QUALITY ASSURANCE

A. Coordinate access to public and private facilities for installation of instrumentation through the Engineer.

B. Where Contractor uses radio or cell phone data transmission systems, they shall be designed to avoid interference with the communications and signal systems of existing facilities. Such data transmission systems shall be designed to ensure against interruptions in the flow of data if owners shut down cell phone service in their facilities, or if cell phone service is interrupted in any part of the Contract area for any reason.

C. A factory calibration shall be conducted on all instruments before shipment. Certification shall be submitted to indicate that the test equipment used for this purpose is calibrated and maintained in accordance with the test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to the NIST.

D. A final quality assurance inspection shall be made before shipment. During the inspection, a checklist shall be completed to indicate each inspection and test detail. A completed copy of the checklist shall be supplied with each instrument.

E. Submit the manufacturer's warranty for each unit of equipment furnished by Contractor.

F. Qualifications of Contractor's Instrumentation Personnel: Contractor's instrumentation capabilities shall include the following:

1. Geotechnical and structural instrumentation work involves highly specialized tasks. Contractor's instrumentation personnel who are responsible for furnishing and installing all geotechnical and structural instrumentation, maintaining instrumentation, as required, and collecting and interpreting data shall have the qualifications specified herein.

2. Furnish the services of a geotechnical instrumentation firm with a minimum of 5 years experience during the last 10 years period in installing and using the instrumentation and CDM system required on this Project on a similar project.

3. Contractor's instrumentation personnel shall include a qualified Geotechnical Instrumentation Engineer (GIE) who is a Professional Engineer licensed in the States in which the Work will be performed, who has a minimum of a Bachelor of Science degree in Civil Engineering, and who has at least ten years of experience in installation and monitoring of the types of instruments specified herein and in interpreting instrumentation data. The Geotechnical Instrumentation Engineer shall:

   a. Prepare detailed step-by-step procedures and schedule with bar chart for the installation of all instruments specified herein.

   b. Be on-site, supervise, and conduct the pre-installation and post-installation acceptance tests of each type of instrument.

   c. Be on-site and supervise at least the first five installations of each type of instrument.

   d. Supervise interpretations of geotechnical instrumentation data.

   e. Supervise instrumentation monitoring and management/dissemination of reduced data to others.

   f. Supervise removal or abandonment of instrumentation.

4. Contractor's engineer designing the layout for optically surveyed instrumentation shall be a Land Surveyor, licensed in the States in which the Work will be performed, with a minimum of three years experience in design work of the types and accuracy specified herein.

5. Contractor's instrumentation personnel shall include an Instrumentation Superintendent who will be in responsible charge full-time on site during the geotechnical and structural instrumentation program. The Superintendent shall have at least six years of direct field experience in installation and monitoring of the types of instrumentation specified herein, and shall have supervised instrumentation programs of similar magnitude in similar subsurface conditions. The Superintendent shall be on site to supervise all instrument installations, pre-installation and post-installation acceptance tests and instrumentation data collection and interpretations when illness or other insurmountable circumstance prevents the Geotechnical Instrumentation Engineer from performing these functions. The Superintendent shall also be prepared at all times to supervise the installation of any instrument after the Geotechnical Instrumentation Engineer has supervised the installation of the first five of any type.

6. Contractor's instrumentation personnel shall include Instrumentation Technicians who have at least one year of experience in the installation and monitoring of the types of instruments specified herein. At least one technician with not less than one year of experience in the logging of boreholes and rock cores shall be available to execute the task whenever the advancement of instrumentation holes by drill rig is in progress and neither the GIE nor Superintendent is available at the site.

7. Contractor's personnel shall include a qualified Information Technology (IT) Engineer who has a Bachelor of Science degree in civil engineering or computer science and a minimum 4 years experience during the past 10 years period setting up, operating and maintaining a CDM system of the type specified herein. The IT Engineer shall:

a. Conduct all pre-installation and post-installation acceptance tests for all CDM systems specified herein.

b. Demonstrate the startup and operation of the CDM system.

c. Be available to manage the continuing operation of the system, including repairs and replacement of damaged system components.

d. Be available to respond to questions and participate in discussions with the Engineer pertaining to any aspect of the CDM system.

G. Contractor's personnel shall include a qualified Automated Motorized Total Station (AMTS) Specialist who shall perform and who is qualified to perform the tasks of the AMTS as specified herein. The AMTS Specialist shall have previous experience in the installation, monitoring, and data interpretation of at least two AMTS network systems in similar applications. The AMTS Specialist shall not be any of the same individuals specified herein above, and shall be subject to approval by the Engineer. From the start of design and design submittal, through the pre-installation acceptance testing, completion of installations and monitoring of AMTS until construction is 200 feet past the first of the target prisms, the AMTS specialist shall be assigned on a full-time basis to the project, on-site or in Contractor's Project Office a minimum of eight hours per workday. The AMTS specialist shall be available for consultation at all times. Full-time availability includes being on-call and reachable by telephone or pager at all times. The AMTS Specialist shall perform the following tasks:

1. Detail the overall configuration and appurtenant hardware and installation procedures for the entire AMTS system including final locations of the components, some of which are shown only conceptually on the Contract Drawings and prepare all AMTS submittals.

2. Perform pre-installation and post-installation acceptance tests.

3. Supervise installation of the system in its entirety.

4. Maintain the system until it is no longer required for the collection of data for this Contract.

5. Collect, reduce, process, plot, and evaluate data to prove functionality before the beginning of baseline monitoring.

6. Replace and repair damaged components until the system is either removed or turned over to the Engineer at completion of this Contract.

7. Perform routine maintenance, including regular checks of residuals as well as changes to the model parameters for the least square model to compensate for obstruction of targets, suspect reference targets, and optimization of atmospheric conditions.

H. System Tests

1. Test the Alert notification system at least once per week by simulating data that exceeds Threshold and Limiting Response Values. The Alert system test shall include a representative of the Engineer in the test. Test sequence, results, and any required corrective actions shall be documented and submitted to the Engineer with the weekly report.

2. Test the Alert System for each user on the notification list by simulating an alert notice at least once per month. Test sequence, results, and any required corrective actions shall be documented and submitted to the Engineer in the next weekly report.

3. Correct any deficiency in the alert notification system within 24 hours.

4. Substitutions for the GIE, the Superintendent, the AMTS Specialist or the IT Engineer during the Contract period shall not be made without prior written approval by the Engineer. Substitute personnel shall have the same qualifications specified herein for the positions to be held.

I. If Contractor installs instruments additional to those specified, or collects data in addition to that specified, Contractor's personnel shall be as follows:

1. Installations shall be supervised by the Geotechnical Instrumentation Engineer or the Superintendent as specified herein above.
2. Data collection, reduction, plotting, and reporting, except for survey data, shall be supervised by the Geotechnical Instrumentation Engineer or the Superintendent.
3. The person in responsible charge of the surveyors shall be a Land Surveyor, licensed in the States in which the Work will be performed, with a minimum of three years of experience (or as approved by the Engineer) in deformation measurements of the types and accuracies specified herein. The field survey party chief shall have a minimum of one year of experience (or as approved by the Engineer) in deformation survey measurements of the types and accuracies specified herein.
4. Interpretations of data shall be supervised by the Geotechnical Instrumentation Engineer.
5. Instrument installation and data collection shall be as specified herein.

J. Contractor's instrumentation personnel including qualifications of the Geotechnical Instrumentation Engineer, the Instrumentation Superintendent, IT Engineer, Technicians, AMTS specialist, Registered Land Surveyor, and field survey party chief shall be subject to the review and approval of the Engineer.

K. All instrumentation personnel working on the Project will be required to take safety training by all relevant authorities before they are permitted to enter the facilities.

1.05 SEQUENCING AND SCHEDULING

A. Furnish and install instruments, collect data, and agree with Engineer on formal initial readings in accordance with the following schedule:

1. Deep benchmarks shall be installed and formal initial readings agreed on at least 60 days before the start of any construction that would be affected by the collection of settlement data.
2. Observation wells and vibrating wire piezometers shall be installed and initial reading of groundwater levels agreed upon by the Engineer and Contractor at least 30 days before the start of construction.
3. As defined elsewhere herein, movement and structure monitoring points and instruments (ES, S1, S2, SM, SP and Tiltmeters) shall be installed and formal initial readings agreed on at least 30 days before any construction activity approaches within 200 feet of the instrument.
4. At least 60 days before commencement of any construction activity, submit detailed instrumentation location plan, including details of installation procedures and timing.
5. To permit the collection of representative baseline data, the AMTS shall be installed so formal initial readings can be taken at the earliest practicable time before construction activity can influence the instrument. Unless otherwise directed or approved by the Engineer, a baseline reading period of three months duration before any construction activity within 200 feet of the instrument is required. AMTS likely

to be affected by the construction activity shall be installed before other instruments in the same general location.

B. If uncertainties over installation priorities arise because of overlaps in construction staging of various Project elements, rework the installation schedule and submit it for review by the Engineer. Variations in the schedule require review by the Engineer.

1.06 STORAGE OF INSTRUMENTS

A. All instrumentation materials, after receipt at the site and before installation, shall be stored in an indoor, clean, dry, and secure storage space. Instruments shall not be exposed to temperatures outside the manufacturer's stated working temperature range.

PART 2. PRODUCTS

2.01 GENERAL

A. All materials shall be new and shall have a design life of at least 12 months beyond the anticipated completion of the Contract in case of the need for post-construction monitoring.

B. Whenever any product is specified by brand name and model number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the product desired. The term "approved equal" shall be understood to indicate that the "approved equal" product is the same or better than the product named in the specifications in function, performance, reliability, quality, and general configuration. This procedure is not to be construed as eliminating from competition other suitable products of equal quality by other manufacturers. Contractor may, in such cases, submit complete comparative data to the Engineer for review. Substitute products shall not be ordered, delivered to the site, or used in the Work unless approved by the Engineer in writing. The Engineer will be the sole judge of the suitability and equivalency of the proposed substitution.

C. Any request from Contractor for consideration of a substitution shall clearly state the nature of the deviation from the product specified. Each request for substitution shall be the subject of a letter transmitted for review before purchase of equipment as specified elsewhere herein. It will not be acceptable for substitutions to be seen by the Engineer for the first time when Shop Drawings are received.

D. Specified readout units, together with associated calibration devices and software, shall be available for use no later than one week before commencing installation of the first of each type of instrument. Furnish readout units as needed for making pre-installation and post-installation acceptance tests, and for taking readings during construction.

E. Furnish all installation tools, materials, and miscellaneous instrumentation components.

F. A factory calibration shall be conducted on all instruments at the place of manufacture before shipment. Each factory calibration shall include a calibration curve with data points clearly indicated, and a tabulation of the data. Each instrument shall be marked with a unique identification number. Quality assurance procedures during factory calibration shall be as specified.

1. Factory calibration of seismograph vibration monitors shall be performed using a shake table and a reference sensor traceable to the NIST. Factory calibrations of overpressure sensors shall be performed using a piston calibrator traceable to the

NIST. Seismograph shall be calibrated yearly. Furnish for adequate supply of comparable instrumentation during calibration to ensure against delay of Project.

G. Surface protection for vertically installed instruments shall be flush with the ground surface in paved or other areas. For all instruments, surface protection shall consist of a Tyler Pipe Model 26T-6855 LF Top Only Roadway Box, or approved equal, with a plain 5-1/4-inch lock-lid, a Bresnahan Foundry Model 00068 Roadway Box with latching lock lid, or approved equal.

H. For each instrument type, furnish an instruction manual that shall include the following:

1. A description of the purpose of the instrument
2. Theory of operation
3. Step-by-step procedures for:
   a. Pre-installation acceptance test when instruments are received on-site, to ensure the instruments are functioning correctly before installation.
   b. Calibration of readout units
4. A list of calibration equipment required for vibrating wire instruments, and recommended frequency of calibration
5. Step-by-step instrument installation procedure including materials, tools, spare parts, and any borehole requirements, and post-installation acceptance tests
6. Maintenance procedure
7. Step-by-step data collection procedure
8. Software requirements and instructions, data reduction, processing, and plotting procedures

I. If not stated otherwise, all graduations shall be in U.S. Customary Units, for example, feet, inches, pounds.

J. Data loggers shall be furnished and installed to collect data from tiltmeters and AMTS's. The data loggers shall be capable of retaining setup information and measurements in memory for 72 hours in case of power failure or power interruption. The data loggers shall have the ability to communication with the IDS units by short-haul or telephone modem. The data loggers shall be Geokon Inc. "Micro-10 Data loggers", or approved equal.

K. IDS units shall be furnished and installed to serve as buffers between the data loggers and the Central Data Management (CDM) System, details of which are specified herein. The IDS units shall receive monitoring data from the data loggers attached to them, consolidate these data, and transfer them to the CDM System by telephone modem. Furnish IDS units that are suitable for performing the required function. As a minimum, the hardware shall include an Intel-based PC with a Microsoft Windows XP operating system, 3.0-gHz or higher processor, 2-GB SDRAM, and a 500-GB hard drive. Each IDS shall be equipped with a CD drive and a 4-G modem for remote access.

L. Software shall be furnished and installed for the IDS units to control and program the data loggers. A method of programming this software shall be furnished and installed, which uses menu-oriented fill-in-the-blanks, or equally easy-to-understand techniques. No special knowledge of computer languages shall be required to program the IDS. The IDS software shall be capable of transferring the monitoring data to the CDM System in a comma-separated ASCII format to be used by the database program. The IDS software shall be Geokon, Inc. "MultiLogger" Software, or approved equal.

M. Each IDS unit shall be furnished and installed with software to enable remote control and operation of the IDS from the CDM System. The remote control software shall be Symantec Corporation "pcAnywhere Version 10.5", or approved equal.

N. Cables to connect instruments with the datalogger/IDS shall be shielded to protect against the effect of stray current and electrical induction, water, and weather, and shall be resistant to vandalism and rodent attack. Use conduits where required.

O. For most instruments, data loggers and IDS units may, with the concurrence of abutters and approval of appropriate agencies, be installed inside buildings or in public spaces. Equipment shall be housed in secure cabinets that are proof against theft, vandalism, rodents and the effects of weather.

2.02 ELEVATION SETTLEMENT PLATFORMS (ES)

A. Settlement Platforms

1. Casing and inner pipe shall be steel pipe conforming to the requirements of ASTM A53, welded, standard weight.
2. Base plate shall be steel conforming to the requirements of ASTM A36.
3. Sand base and sand fill shall be drainage blanket material.

2.03 DEEP BENCHMARKS (DB)

A. A deep benchmark shall comprise a sleeved steel pipe grouted into competent rock defined as unweathered to slightly weathered rock with a Rock Quality Designation (RQD) of 50% or greater and minimum Recovery of 90% for each 5-ft core run.

B. The inner pipe shall be 1-1/2-inch, Schedule 40 steel pipe, threaded and coupled. The couplings shall have 45-degree tapered shoulders across the full coupling wall thickness at both ends. The top of the pipe shall be fitted with a hemispherical stainless steel knob.

C. The outer casing shall be 4-inch Schedule 40 steel pipe, threaded and coupled.

D. The centralizers shall consist of PVC pipe sized to provide a tight fit on the inner pipe and spring-formed with longitudinal cuts to a larger diameter to provide a loose fit in the outer pipe. They shall be spaced on 10-foot vertical centers.

E. Cement grout shall be ordinary Portland cement and water.

F. Caulking compound shall be silicone based commercial grade.

G. Bentonite slurry shall consist of bentonite and water.

H. Surface protection shall be flush with the ground surface and incorporating a Roadway Box as specified Paragraph 2.01.G.

2.04 OBSERVATION WELLS (OW)

A. Furnish and install observation wells with slotted pipe, bottom caps, and vented top caps as indicated on the Contract Drawings. The slotted pipe shall be 5-feet long, 2-inch, Schedule 80 PVC pipe with three rows of 0.01-inch wide slots on 120-degree centers, with a slot length to leave 0.25-inch between rows. The standpipe shall be 2-inch, Schedule 80 flush-joint PVC pipe.

B. Filter sand shall conform to ASTM C778.

C. Electrical water level indicator shall have a 100-foot long graduated cable with graduations at 0.02-foot or smaller intervals.

D. Surface protection shall be flush with the ground surface and incorporating a Roadway Box as specified in Paragraph 2.01.G.

E. Granular bentonite shall be Wyo-Ben, Inc. "Enviroplug Medium; Petroleum Services, Inc., Baroid Division "Holeplug"; or approved equal.

2.05 VIBRATING WIRE PIEZOMETERS (VP)

A. Furnish and install vibrating wire (VP) piezometers, Geokon Inc. Model 4500S, Geonor Inc. Model M-610, or approved equal. Piezometers shall have a range of 50-psi, an over-range rating of twice the rated pressure, plus or minus 0.2-percent full-scale accuracy, and 0.025-percent full-scale resolution, and shall be fitted with a low air entry filter.

B. Furnish and install cable from the same commercial source as the piezometers, either 4-conductor, 22-gauge, with two shielded twisted pairs, a common drain wire, and a sheath of 0.065-inch thick pressure extruded vinyl with an outside diameter of 0.25-inch, or Geonor Model P540, or approved equal. Cable shall be attached to the piezometer pressure transducer through an integral bulkhead seal, consisting of an interior waterstop seal and a cable entry seal. Seals shall be either "O" rings or hermetic seals. The seals shall have been tested and certified for watertightness over the specified pressure range of the piezometers.

C. Cabling shall be supplied in lengths such that jointing is reduced to a minimum.

D. Furnish and install readout and other terminal units from the same commercial source as the piezometers. The readout unit shall be capable of reading both the vibrating wire and thermistor reading, shall have a minimum of 64-kilobytes of random access memory (RAM), and shall display readings in engineering units.

E. Filter sand shall conform to ASTM C778.

F. Granular bentonite shall be Wyo-Ben, Inc. "Enviroplug Medium; Petroleum Services, Inc., Baroid Division "Holeplug"; or approved equal.

G. Special grout Type A shall consist of uniform-sized fine ground or powdered non-drilling mud grade bentonite, for use in sealing and grouting well casings. A polymer-based thixotropic additive may also be added to the mix if recommended by the manufacturer. Special grout Type A shall have a mixed specific gravity, prior to placement within the instrument borehole, of between 1.03 and 1.10.

H. Cylindrical sounding hammer shall be a steel cylinder with outside diameter of 0.3- to 0.5-inch less than the inside diameter of the casing or augers, an inside diameter of 0.15- to 0.25-inch larger than the outside diameter of the cable, a length of not less than 2 feet, and a weight of 10 to 20 pounds.

2.06 SURVEYING INSTRUMENTS FOR VERTICAL MOVEMENT MONITORING

A. The following requirements for vertical movement monitoring by optical survey apply to data collection as defined elsewhere herein. Instruments used for vertical movement monitoring shall have a minimum accuracy of plus or minus 0.06-inch (standard deviation for one kilometer of double run leveling) and a minimum setting accuracy of plus or minus 1.0-arc seconds. Leveling staffs shall be non-telescopic in design (i.e., 'Chicago' style leveling staff). A bull's eye bubble shall be used to plumb the leveling rod. For establishing the elevations of Deep Benchmark reference heads, use equipment compatible with First Order surveying.

2.07 SURVEYING INSTRUMENTS FOR HORIZONTAL MOVEMENT MONITORING

A. The following specification for horizontal movement monitoring applies to data collection as defined elsewhere herein. Instruments used for horizontal movement monitoring shall have a minimum accuracy of plus or minus 3.0-arc seconds (standard deviation according to DIN 18723), and a minimum display reading less than or equal to the accuracy. Distances less than 30-feet shall be measured with a standardized steel tape used in conjunction with a tension handle. Distances greater than 30-feet shall be measured with an Electro-Optical Distance Measuring Instrument (EDM). Distances between 30- and 100-feet shall be verified with a standardized steel tape in conjunction with a tension handle. Electronic pointing shall be used to minimize error due to possible misalignment of the EDM axis and telescope. Centering shall be accomplished using high precision optical plummets or mechanical centering devices.

B. EDM equipment used for horizontal movement monitoring shall, after calibration, have a minimum accuracy of plus or minus 0.2-inch plus 5-parts per million.

2.08 MOVEMENT MONITORING

A. Movement monitoring points shall be used to monitor vertical and horizontal displacement of various facilities at selected locations shown on the Contract Drawings.

B. The following types of monitoring points shall be used to monitor ground deformation:

1. Surface Monitoring Point Type 1 (S1) shall consist of a 1-inch diameter extra-strong steel pipe that extends at least 5-feet-6-inches below ground surface.
2. Surface Monitoring Point Type 2 (S2) shall consist of a 1-inch diameter extra-strong steel pipe that extends at least 6-feet below the top of pavement. Split pipe at tip for 1-foot as shown on the Contract Drawings.
3. Elevation settlement platforms (ES) are surface displacement reference platforms placed on the prepared ground surface as shown on the Contract Drawings and before placement of the embankment fill. A settlement platform consists of a square steel plate to which risers are attached. The risers are extended as the embankment is placed. Settlement platforms are monitored by optical survey methods to determine vertical displacements occurring during and after preload fill placement.
4. Structure Monitoring
   a. Structure monitoring points (SM) shall be suitable for installation in surfaces such as steel, concrete, masonry, and mortar joints. For anchorage of instruments, use a sleeve, an anchor, and a bolt as shown on the Contract Drawings or redesigned as appropriate, and approved by the Engineer. Anchor sleeves and anchors can be obtained from Hilti and ITW Ramset/ Red Head; or approved equal, as recommended by the instrument manufacturer.
   b. Structure monitoring points shall be for horizontal movement, and settlement monitoring of structural elements, columns, facades, walls, and pillars.
   c. For settlement monitoring at vertical surfaces, use structural monitoring point on vertical masonry or concrete surface (SM) as required or shown on the Contract Drawings to facilitate the reception of the leveling staff. The SM shall consist of a bolt that protrudes from the vertical surface.
   d. For locations where structure monitoring points (SP) are used for the monitoring of structures, install high precision optical survey prisms and Automated Motorized Total Stations (AMTS) as specified herein and as shown on the Contract Drawings.

C. For tilt monitoring of structures, use tiltmeters (TM) as specified herein below.

1. Each tiltmeter shall be biaxial and shall incorporate tilt transducers that are electrolytic levels (also referred to as electro-levels), vibrating wire transducers, accelerometers, or magneto-resistive transducers. A temperature sensor shall be incorporated into each tiltmeter.

2. The tiltmeters shall have been proven by data obtained during either a minimum of three project applications similar to the specified application, or by laboratory testing, acceptable to the Engineer, to have the performance characteristics specified herein.

   a. Minimum angular range plus or minus 1-degree

   b. Operating temperature range minus 10 to plus 100-degrees Fahrenheit

   c. Static repeatability of plus or minus 2-arc-seconds or better

   d. Maximum temperature sensitivity throughout the entire angular range and operating temperature range of plus or minus 40-arc-seconds

   e. Zero stability over a minimum period of 90 days at a constant temperature of plus or minus 5-arc-seconds or better.

3. The tiltmeter electrical cable shall be as recommended by the manufacturer of the tiltmeters and shall be shielded with a waterproof jacket.

4. Portable readout units and dataloggers shall be as recommended by the manufacturer of the tiltmeters. Each tiltmeter shall be furnished and installed with a datalogger. A portable readout unit shall be furnished and installed for use during installation and for subsequent duplicate readings.

5. Housings and mounting brackets shall be as recommended by the manufacturer of the tiltmeters.

6. Factory calibration of tiltmeters shall consist of calibrations on a mechanical tilting table with a range of plus or minus 1-degree in a minimum of ten equal increments.

7. Each tiltmeter shall be protected from damage by installing a protective box furnished by the manufacturer, a NEMA 3R enclosure, or equivalent, of appropriate size to enclose the tiltmeter and to allow for connection to the datalogger(s).

2.09 SEISMOGRAPHS

A. Furnish portable seismographs for use in monitoring of velocities of ground vibrations resulting from construction activities. Furnish Instantel Inc. "BlastMate Series III", or approved equal. The seismographs shall have the following minimum features:

1. Seismic Range: 0.01- to 10-inches per second with an accuracy of plus or minus 5-percent of the measured peak particle velocity or better at frequencies between 10- and 100-Hertz, and with a resolution of 0.01-inch per second or less.

2. Acoustic Range: 88- to 144-dB(L) (referenced to 20-micro-Pascals) with an accuracy and resolution of plus or minus 1-decibel.

3. Frequency Response (Plus or Minus 3-Decibel Points) 2- to 200-Hertz.

4. Three channels for vibration monitoring plus a fourth channel for overpressure because of blasting.

5. Two Power Sources: Internal rechargeable battery and charger and 115-volts ac. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.

6. Capable of internal dynamic calibration.

7. Capable of printing in the field and capability to transfer data from memory to permanent storage medium. Instruments must be capable of producing strip chart recordings of readings on-site within one hour of obtaining the readings.

8. Furnish and install computer software for performing analysis, produce reports of continuous monitoring, and to perform zero-crossing frequency analyses of waveform data on magnetic disks.

9. Self-triggering waveform capture mode that provides the following information: plot of waveforms, peak particle velocities, peak overpressure, and frequencies of peaks.

10. Continuous monitoring mode capable of recording events up to 10-seconds long, and histogram mode to record events continuously.

B. Geophones shall be external to the seismograph to allow solid bolting of the geophone to concrete or pavement surfaces with "Red Head" anchors, or approved equal as shown on Contract Drawings.

2.10 AUTOMATED MOTORIZED TOTAL STATIONS (AMTS)

A. Furnish and install high precision optical survey prisms in conjunction with fully automated motorized total stations under computer control to provide real-time movement monitoring at locations identified on the Contract Drawings and as directed by the Engineer. The system shall provide the means to remotely monitor the three components of movement of precision targets mounted on bridge columns and other structures.

B. The monitoring system shall provide three-dimensional displacement vectors for all the survey prisms with a measurement precision of plus or minus 1-millimeter for sight distances up to 100-meters. The system shall be configured to report the monitoring data on the project grid.

C. The monitoring system shall have been proven to have the performance and accuracy specified herein in at least one project that includes the types of structures being monitored in this Contract.

D. Each system shall consist of:

1. A motorized total station Leica Model TM30, or approved equal, including mounting cages, brackets, and protective arrangements. Quantities and locations are to be determined by the Contractor's AMTS Specialist and approved by the Engineer.

2. High precision optical survey prisms

3. High precision optical reference prisms. Quantities and locations are to be determined by the Contractor's AMTS Specialist and reviewed by the Engineer.

4. On-site equipment to operate the total station and communication with the CDS including combined power/signal box, AC to DC charger/transformer, power supply, connections, backup battery, transceiver modem, and associated cabling.

5. A site to designated office data transmission link comprising either a radio modem with antenna and housing to provide wireless digital transmission of data between the total station controller and the designated office, or cable modem and cabling, and/or dedicated telephone lines or cabling as required.

6. Receiver equipment at the designated office comprising a signal box and transceiver modem and cabling to connect to the CDS

E. The monitoring system shall be capable of providing temperature readings that coincide with the instrument readings, and shall take into account temperature and pressure variations in real time once per cycle so that it is insensitive to the effects of refraction.

F. The monitoring system shall include statistical analyses that shall be made at the end of each cycle of readings in order to maximize the precision of measurements.

G. The monitoring system shall incorporate a limited search window and a limited time for searching for a survey prism so that if the search is unsuccessful because of prism damage or other causes, the system will pass to the next prism in the cycle. In this event, the result for the missing prism shall be identified as "no result". If the system is unable to find and read this prism during the following cycle, the system shall send an alarm message indicating that the prism is missing.

H. The monitoring system shall be capable of providing three-dimensional displacement data for a maximum of 50 prisms associated with each total station within a period of one hour.

I. The monitoring system shall provide differential calculations between prisms in real time.

J. The monitoring system shall be configured to form a global network system for all total stations monitoring units with the use of common targets monitored by the total stations units. The monitoring system shall have the ability to process a global least squares adjustment of data that are acquired by several total stations in each measurement cycle so that if one or more total stations require the use of a reference target associated with a different total station, a global monitoring network can be set up to relate to a single reference target.

K. The monitoring system shall be capable of retaining setup information and measurements in memory for a minimum period of 72 hours in case of power failure or power interruption.

L. Keep the total station theodolites operational within the manufacturer's specified operating temperature range.

2.11 GRID CRACK CAGES (CG)

A. Furnish and install grid crack gauges. Grid crack cages shall be as manufactured by Avongard Products (USA) Ltd., or approved equal. Anchors, bolts, screws and quick setting epoxy shall be as furnished by Avongard Products or approved equal. Install crack gauges at locations directed by the Engineer as the construction work progresses.

2.12 DATA MANAGEMENT EQUIPMENT

A. Furnish and install an integrated system that automatically collects data from geotechnical instruments connected to dataloggers and places it into a secure database. The system shall also include all data from manually read instruments, optical surveys, and portable Total Stations. The system shall be Geocomp Corporation "iSite Central Data Management System", or approved equal.

B. The data management system shall be able to display current readings in engineering units for any sensor or monitoring point and display the entire history of readings for the sensor or monitoring point via a web browser.

C. The system shall be able to record readings of any sensor or monitoring point from instruments connected to dataloggers at a rate of 200 per hour if construction-related movements or stresses indicate the need.

D. Furnish and install the data management system with the following minimum capabilities:

1. To have remote communications between dataloggers and the CDM system with communications initiation features at both ends.
2. To collect or receive data from dataloggers and store all records in an approved database.
3. To make data available for reporting via the web interface within 2 minutes of the data being collected by datalogger or input from manually monitored instruments.
4. To generate alerts by e-mail and pager for up to 10 addresses when data collected from any instrument is determined to be outside of set tolerances.
5. Upon the occurrence of a notice level (the reaching of an Alert Threshold or Limiting Response Value), to read all sensors connected to dataloggers and the results made available on the WEB within 5 minutes.
6. To log all alerts in the database for subsequent reporting.
7. To include the identifier of the instrument exceeding an Alert Threshold or Limiting Response Value, the date and time of the reading in engineering units, and the Alert Threshold or Limiting Response Value exceeded in engineering units.
8. To provide capability for the person receiving the alert to acknowledge receiving the message and to disarm subsequent alerts from that sensor.
9. To provide messages to users whenever any part of the automated system is not fully functioning, together with the estimated time at which that part will become fully functional.

E. Furnish and install a web-based user interface that can be run from any web browser to allow a complete review of project data that:

1. Provide password-protected access and different user levels including administrators, project managers, project users, and guests.
2. Shows graphically the monitoring points/locations in relation to relevant Project features such as new construction, existing bridge piers, existing buildings, and existing services.
3. Gives users the ability to choose which project features and monitoring points are displayed.
4. Displays real time data, i.e., the most recent monitoring data within 5 minutes of collection or downloading into the system
5. Displays all data collected since the beginning of the Project for any/all instruments for time period indicated by the user.
6. Provide user with the ability to review data in either raw or engineering units and either in tabulation of data or graphic representation.
7. Display a summary report of the current active alerts from all active instruments together with current alert levels for each instrument. All readings that exceed the Alert Threshold Value shall be displayed in amber. All readings that exceed the Limiting Value shall be displayed in red.
8. Provide a comment field tied directly to each reading that is editable by Project users and above. Additional comment tracking capabilities for daily Project-related comments shall also be provided to allow general comments to be added; comments shall be identifiable by the user who entered the comment.

9. Provide print reports, either formatted to a printable screen resolution or outputted as a printable version of the report.

10. Support export of reports to comma-delineated and XML (Extended Markup Language) formats for import into other applications. (Additional details on reports are included elsewhere herein.)

F. Furnish and install secondary servers and communications links that automatically take over the functions of the primary servers in case of power failure or other disruption. The secondary servers shall be based in a facility that is physically separate from the primary and shall not receive their electrical power from the same distribution circuit as the primary.

2.13 CDM SYSTEM REQUIREMENTS

A. General: This Section specifies the minimum system requirements. Furnish, install, and support all network electronics, software, cables, and components necessary for full system operation for the duration of the Contract. The system shall be capable of supporting additional monitoring instruments if they become necessary.

B. Web/Application Server

1. Minimum Systems Requirements:

   a. 64-bit Intel® XeonTM 2.8GHz processor, 800MHz front side bus, 1MB L2 cache

   b. 500GB of hard drive disk space

   c. 2GB of RAM

   d. Microsoft SQL server (or approved equal) with support for up to 10 simultaneous users.

   e. Support Ethernet communications, minimum Ethernet capacity shall be full duplex 100Mbps

   f. Automatic roll over system operation to a co-located unit operating with an independent power supplier and Internet provider

2. Support Services

   a. Furnish power, communications, maintenance, licenses and related support services for this equipment for the duration of the contract.

   b. Furnish secure storage for the WEB/Application Server and co-located facility at site convenient for the GIF (Graphic Interchange Format).

2.14 USER SECURITY AND AUTHORIZATION

A. User Levels

1. Administrator/project manager having unlimited access to all system features.

2. Project user shall have access to the data presentation and reporting features only to review, print and download data.

3. Guest users shall have access to data presentation and reporting features for a specified instrumentation or group of instruments only.

B. Password

1. System access shall be password protected, including web interface access and direct connections via RS232/USB/other to the instrumentation data logging equipment.

2. Project database shall be backed-up daily to a separate physical location from the web server.

C. Communications Security

1. If collected data are transmitted over a public infrastructure (such as the internet), or over a wireless communication channel, it must be encrypted with one of the following standards:
   a. 168-bit Triple Data Encryption Standard (3DES)
   b. 128-bit Advanced Encryption Standard (AES)
   c. 128-bit Secure Socket Layer (SSL)
2. Equivalent encryption schemes will be allowed provided documentation can be supplied supporting the encryption strength of the cipher.
3. All electronic equipment shall be equipped with firewalls and other appropriate protection measures to prevent unauthorized entry to the system or unauthorized use of the data.

PART 3. EXECUTION

3.01 PRE-INSTALLATION ACCEPTANCE TESTS

A. When instruments are received at the installation site, Contractor's instrumentation personnel shall perform pre-installation acceptance tests to ensure that the instruments and readout units are functioning correctly before installation. Pre-installation acceptance tests shall include relevant items from the following list:

1. Examine factory calibration curve and tabulated data, to verify completeness.
2. Examine manufacturer's final quality assurance inspection checklist, to verify completeness.
3. Check cable length.
4. Check tag numbers on instrument and cable.
5. Check, by comparing with procurement document, that model, dimensions, and materials are correct.
6. Perform resistance and insulation testing, in accordance with criteria provided by the instrument manufacturer, using a gauge insulation or circuit tester that applies 2 volts or less for resistance testing and 15 volts or less for insulation testing.
7. Verify that all components fit together in the correct configuration.
8. Check all components for signs of damage in transit.
9. Check that quantities received correspond to quantities ordered.

B. During pre-installation acceptance testing of each instrument Contractor's instrumentation personnel shall complete a pre-installation acceptance test record form.

C. An instrument that fails the specified pre-installation acceptance test shall be repaired such that it passes a subsequent pre-installation acceptance test, or shall be replaced by an identical instrument at no additional cost to the Authority.

3.02 INSTALLATION - GENERAL

A. Verify that instrumentation locations shown on Contract Drawings and determined by Contractor in accordance with the Contract Documents are suitable for the intended purpose and that they will not interfere with ongoing or planned operations. Where they

are not suitable, after submittal to and review by the Engineer, move them to locations that are suitable; then install instruments in accordance with Contractor's detailed step-by-step procedures. Contractor's instrumentation personnel shall install instruments in accordance with Contractor's detailed step-by-step procedures that were submitted and approved by the Engineer.

B. Drilling

1. The following personnel requirements shall apply to all Contractor and specialty subcontractor for drilling activities associated with instrumentation installation, and shall apply on all property including project rights-of-way, private property, and city streets.
2. Obtain all permits that include, but are not limited to, permissible days and hours for work in each drill site.
3. Arrange for utility clearance at each drill hole in accordance with the Utility Clearance Procedure including documentation relating to Code 53 verifications and completion and signing of the Utility Clearance Checklist.
4. Before beginning operations, Contractor's drilling personnel shall attend a safety briefing arranged by the Engineer.
5. Locate drill holes a minimum of 3-feet horizontally from any identified utility. Where necessary, a hole may be located within 3-feet, but in no case less than 2-feet from any utility.
6. Verify that the drill rig is electrically grounded when drilling near electrical facilities.
7. Ensure that all drilling personnel working at the rig wear electrically insulated gloves as part of the personal protective equipment when drilling at depths from 0- to 10-feet. All hand tools shall be electrically insulated when used at the rig for hand augering/excavation.
8. Ensure that all drill holes are, without exception, hand-augered or hand-excavated to a depth of 5-feet minimum. If the hole is located within 3-feet horizontally of any identified underground utility, then hand-augering/ excavation shall proceed to a minimum depth of 6-feet.
9. In streets, electric or pneumatic thin wall coring will be permitted for drilling the pavement until the top of subbase. Use of powered rotary drill rigs shall not begin before hand-augering/excavation to the depth required herein above.
10. Contractor may elect to proceed with excavation of a pit without first demonstrating refusal of a hand auger. The pit may be excavated using electric or pneumatic tools with a chisel to break the pavement.
11. All work at street locations shall be cordoned off. Where a pit has been excavated, backfill the pit or construct a proper working surface to ensure that the drillers proceed with a safe working surface.
12. Consider all utilities to be live or operational, terminate drilling activities immediately if utilities are encountered at the actual drill hole location, and implement the Project Emergency Notification 002 as circumstances warrant.
13. Boreholes for instruments shall be drilled by a method that results in a clean and stable hole of the required diameter to the correct depth. Boreholes shall be cased to their full depth unless strata are sufficiently competent for the hole to stay open using water or slurry. Boreholes shall be drilled using clean water. Drilling mud or polymer additives shall only be used as directed by the Engineer. In the case of installation of observation wells and piezometers, drilling mud or polymer additives

will not be permitted. Care shall be taken during drilling to ensure that a minimum of material is lost from outside the casing. Surging of casing will not be allowed, and flushing of drilling water up the outside of the casing shall be avoided.

14. If an instrument boring cannot be properly advanced to the required depth, or the proposed testing and instrumentation cannot be satisfactorily completed, it shall be terminated. Perform whatever work is required to advance a replacement boring to the depth where the initial boring was terminated while using the drilling technique specified herein. In all cases, the boring shall ultimately be advanced to the depth indicated on the Contract Drawings.

15. Safely dispose of any effluent water, material cuttings, and refuse in accordance with applicable regulations and relevant Environmental Speciation Sections. Coordinate the disposal with authorities having jurisdiction, and submit disposal plan to the Engineer for review and approval.

16. Rock cores shall be recovered from all borings intended for the installation of instruments in accordance with the requirements of each instrument type as specified elsewhere herein. Where the full column of rock does not need to be cored, every effort shall be made to recover core through the full depth of weathered rock and the upper 5-ft of competent rock defined as unweathered to slightly weathered rock with a Rock Quality Designation (RQD) of 50% or greater and minimum Recovery of 90% for each 5-ft core run.

17. Core barrels shall be double-tube or triple-tube type with non-rotating inner barrels of the Acker M Series, Christensen NWC or NWD Series, or approved equal. Wire line equipment and tools may be used. The equipment and procedures used shall be such that NX (2-1/8-inch outside diameter) cores, or, if wire line equipment is used, NQ (1-7/8-inch outside diameter) cores can be obtained in all borings. Cores shall be pulled at intervals not exceeding 5-feet unless it can be shown to the satisfaction of the Engineer that larger runs produce equal or better recovery and quality of core. In any case, the first run shall be no longer than 5 feet, and no runs shall be longer than 10 feet. Core shall be pulled at the first sign of blockage or grinding. If core recovery is poor, make every effort to improve the recovery and sample quality by changing bit types and altering drilling rates, or shortening runs, by increasing drilling fluid circulation, or by whatever other methods are required.

    a. The core obtained in each drilling operation shall be placed in 5-foot long wooden core boxes and divided into separate compartments, each the length of the box and the width of the core obtained. The core boxes shall be approved by the Engineer. Core obtained shall be placed in these boxes in such a manner that the various strata are in the same relative position in the core box as they were in the ground. The order of placing cores shall be the same in all core boxes. The top end of each core and the bottom of the last core shall be clearly and permanently marked with its true depth. A separate core box shall be used for each boring. The outside of each box shall be marked on top with the Project name, Project number, boring number, depth, and box number. Both ends of the boxes shall be marked with the boring number and core depths. Boxes shall be fitted with handles on the ends in order to facilitate lifting.

    b. Special care shall be taken by the instrument installer/borehole inspector to locate and note the depth and thickness of all clay or mud seams or cavities. These shall be clearly shown in each box and on the drilling log. Wherever core is lost or at any known seam or cavity, a spacer shall be placed in the proper relative position in the core box. The space shall be the length of the core lost or the

length of the cavity, and shall be marked with the top depth and length of the missing core and the nature of the missing segment (e.g., "lost core", "cavity", etc.). Any core that is removed from the box for testing or any other purpose shall be replaced by a spacer equal in length to the removed core, marked with the date, purpose, and name of the party responsible for the removal. The total length of core obtained and the corresponding distance drilled shall be shown on the boring log for each core pulled. Wooden blocks marked with the appropriate elevations or depths shall be inserted between each pull of core. The blocks may be marked in either depth or elevation, but not both, and the marking system shall be consistent for all borings, both for the logs and boxes used for cores.

c. The time required to drill each 12-inches of depth shall be noted and recorded.

d. All recovered samples and rock cores shall be transported to an intermediate, Contractor-selected storage facility within 10 miles of the Project where they can be conveniently examined by the Engineer. Afterwards they shall be moved to the Authority's permanent storage facility, if directed by the Engineer.

C. Installation procedures for instruments in boreholes shall be such that all steps in the procedure can be quality assured. Granular bentonite shall be placed in depth increments not exceeding 2 feet. Volumes of each increment of backfilling with sand shall be small enough such that no bridging occurs. The depth to the top of each increment of sand or granular bentonite shall be checked after placement.

D. Place grout using a tremie method with side discharge ports on the tremie pipe.

E. Before installing any instrument through drill casing or augers, thoroughly remove all material adhering to the inside of the casing or augers, and all cuttings.

F. Whenever withdrawing drill casing or augers during instrument installation in a borehole, take care to minimize the length of unsupported borehole and the rate of casing or auger withdrawal. Use procedures that will avoid collapse of the borehole. Do not allow backfill material to build up inside the casing or auger such that the instrument is lifted as the casing or auger is withdrawn. Withdraw the casing or auger without rotation. The casing or auger may be omitted, if allowed by the Engineer, only where it can be shown that instrument installation without the casing or auger will not cause collapse of the borehole or in any way adversely affect instrument installation. If casing or augers are omitted, or the Engineer allows withdrawal of casing or augers before instrument installation, the following requirements shall apply:

1. Install the instrument in the borehole in a continuous operation, starting when instrumentation materials are first placed in the borehole, and do not interrupt before complete backfilling of the borehole to the ground surface.

2. Do not leave partially completed instrument installations in unsupported boreholes overnight or longer without the prior written concurrence of the Engineer.

G. Notify the Engineer in writing, at least 24 hours before installing each instrument.

H. Install instrumentation, in addition to that specified in Contract Documents, that Contractor deems necessary to ensure the safety of personnel and the Work, at no additional cost to the Authority. Notify the Engineer at least 24 hours before installing any such additional instrumentation. Data resulting from such instrumentation will be accepted by the Engineer only if the data are obtained from instrumentation furnished, calibrated, tested, installed, and maintained as specified herein, if the data are collected and plotted as specified herein, and if submitted to the Engineer within one month of data collection.

I. Extend installed instrumentation and reinstall roadway boxes as necessary as grade changes occur, and revise instrument reference elevations as necessary.

J. All instruments shall be labeled with their reference number at the location where readings or measurements are taken. The labeling shall be permanent using a method or material approved by the Engineer.

K. As each instrument is installed, an installation record sheet shall be prepared and submitted, including appropriate items from the following list:

1. Project name
2. Contract name and number
3. Instrument type and number, including readout unit
4. Planned location in horizontal position and elevation
5. Planned orientation
6. Planned lengths and volumes of backfill
7. Personnel responsible for installation
8. Plant and equipment used, including diameter and depth of any drill casing or augers used.
9. Date and time of start and completion
10. Spaces on record sheet for necessary measurements or readings required at hold points during installation to ensure that all previous steps have been followed correctly, including instrument readings made during installation.
11. An inspector's log of subsurface data indicating the elevations of soil and rock strata changes encountered in the borehole, and to the extent that is possible by recovering grab samples and observing drill water return in other boreholes. Strata nomenclature and description shall be based on pertinent Port Authority standards. Driller's logs are not required for instrumentation boreholes.
12. Type of backfill used.
13. As-built coordinates in horizontal position and elevation including:
    a. Horizontal position referenced to Project Baseline Station and Offset, together with the location of the point used for horizontal position measurement.
    b. A location sketch showing the instrument number, taped horizontal distances to the instrument, measured to an accuracy of plus or minus 1 foot from permanent physical features in the field. A sufficient number of taped measurements shall be included on the sketch to establish a unique horizontal position for the instrument. If such features are removed, submit a new sketch, before removal, with taped measurements to other features.
14. As-built orientation
15. As-built lengths and volumes of backfill
16. Result of post-installation acceptance test
17. Weather conditions at the time of installation
18. A space on record sheet for notes, including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

L. Before being accepted, all instruments are required to undergo post-installation tests that demonstrate proper installation and function. Test requirements are either included directly in this section or are developed by Contractor during preparation of detailed step-

by-step procedures that have been submitted to the Engineer for review. As a minimum, an acceptable test shall consist of a series of three readings that fall within the range of repeatability stated in the manufacturer's instrument data sheet.

M. An instrument that fails the specified post-installation acceptance test shall be replaced by an identical instrument at no additional cost to the Authority.

N. After installation, roadway boxes shall be free draining. Roadway boxes that are not free draining shall be repaired or replaced at no additional cost to the Authority.

O. Submit updated as-built instrument coordinate plans to the Engineer. The location plans shall be reproducible composite plans of all installed instruments plotted on 24-inch by 36-inch sheets at a scale of 1-inch equals 40 feet. The first plans shall be submitted within one month after completion of the first instrument installation, regardless of instrument type. Updated plans shall be submitted every subsequent four weeks. Updated plans need not be submitted for periods during which no instruments have been installed. For Contractor's convenience, planned instrument locations will be made available by the Engineer in Autocad format.

P. Before instrument installation, the conditions of each instrumented area shall be photographically recorded and a standardized record submitted to document the conditions. Where applicable, the conditions of surrounding structures shall be included.

3.03 INSTALLATION OF ELEVATION SETTLEMENT PLATFORMS

A. Settlement platforms shall be constructed as specified herein at the locations shown on the Contract Drawings before placement of the permanent embankment fill material. Settlement platforms shall consist of square platforms installed on a sand base on the original ground surface or as indicated on the Contract Drawings with a vertical pipe precisely marked to indicate distances above the plate, extending up through the permanent embankment fill and surcharge fill. They shall be fabricated according to the details specified herein.

B. The settlement plate shall be placed on sand base. The sand base shall be tamped to provide a firm, unyielding and level bearing surface for the base plate. The original ground surface must be stripped of all pavement and vegetation to provide a level base of sand for the settlement plate. The vertical pipes shall have a maximum length of 4 foot for each section. Spacers shall be furnished and installed between the riser pipe and casing pipes at intervals of 4 feet maximum to ensure concentricity. A container or protective casing with both ends open shall be placed around the initial length of casing pipe. This container shall be backfilled with tamped clean sand or gravel to support the pipe in a vertical position during fill placement until the fill is carried above the platform.

C. As the height of fill above the settlement plate changes, the casing and settlement measuring pipes shall be increased or decreased in a maximum of 4 foot increments to maintain the top of the pipe and casing above the permanent embankment fill and surcharge fill. As each additional length of pipe is added or removed, the pipe cap on the casing shall be immediately transferred to the top section on the settlement plate to prevent fill material from entering the casing.

D. The casing pipe shall be marked by flags to clearly show its location and to warn equipment operators and others of its location. Contractor shall maintain the flags during the Contract, and replace those that are missing.

E. Contractor is responsible for maintaining the settlement platforms in working order during the Contract. Settlement platforms damaged by Contractor's construction

operation shall be repaired or replaced by Contractor, at Contractor's expense, within three calendar days after being damaged.

F. Contractor shall request a joint initial survey from the Engineer upon the completion of the installation of the settlement platforms. The Engineer shall be given a minimum two working days notice before survey services are required.

G. The settlement plate risers shall at no time rise more than 4 feet above over the surrounding ground surface elevation. Sections shall be added or removed as necessary during filling to maintain the tops of the pipes at least 12 inches above the surface of the fill.

H. The settlement plate risers shall be surveyed by the Contractor immediately before and after additional extensions are added or removed. Contractor shall notify the Engineer at least two working days before extension or removal of the settlement plate risers.

3.04 INSTALLATION OF DEEP BENCHMARKS

A. Deep benchmarks shall be installed at the locations and depths presented on the Contract Drawings or at alternative locations proposed by Contractor and approved by the Engineer.

B. Drill ahead of outer casing as required to penetrate dense soil and weathered and fractured rock.

C. Drill and sample penetrated materials in accordance with the requirements specified elsewhere herein.

D. The outer casing shall be seated firmly within weathered and fractured rock. Drill below the outer casing into competent rock, as defined above and to the depth shown. Blow out soil and rock fragments from the drilled hole with compressed air of sufficient pressure introduced at the bottom of the drill hole.

E. The bottom of the inner pipe for most benchmarks shall be as shown, a minimum of 12-feet within competent rock, as defined above and as determined from examination of rock cores recovered by Contractor during the drilling.

F. Relative depths of couplings on the inner and outer pipes shall be planned such that there will be no possibility of them being alongside each other at any time during construction.

G. The annulus between the inner and outer pipes shall be filled with bentonite slurry.

H. Grout consisting of Type I or Type II Portland cement and water shall be placed in drilled hole, and inner pipe shall be seated by penetrating into the cement grout as shown.

I. During assembly and lowering into outer casing, centering devices shall be installed between the inner pipe and outer casing as shown.

J. Stainless steel ball reading point shall be welded to top end of the inner pipe.

K. After completion of installation, the as-built elevation of the stainless steel hemispherical stainless steel knob shall be determined through First Order Surveying to an accuracy of plus or minus 0.02-inch and its horizontal position shall be determined to an accuracy of plus or minus 0.3-foot.

3.05 INSTALLATION OF OBSERVATION WELLS

A. Install observation wells at the locations and depths shown on the Contract Drawings.

B. Installation

1. For each observation well installation, drill hole using water as the drilling fluid, and support hole by using hollow stem auger or by installing temporary casing. The minimum diameter of the hole shall be 4 inches. Keep log of soils encountered during drilling and submit to the Engineer.
2. When drilling is completed, flush hole with clean water to remove drilling fluid and clean inside of casing or auger.
3. Place 2-feet minimum of filter sand in the bottom of the hole. Then, insert the well screen and standpipe assembly into the hole. Fill the annulus between the well assembly and the wall of the hole with filter sand to within 1-foot minimum above the well screen, withdrawing the hollow stem auger or temporary casing as the sand is placed to prevent caving of the hole around the filter medium or standpipe.
4. Seal the hole with 3 feet minimum of bentonite above the filter sand and fill the remainder of the hole to 2 feet below ground surface with Portland cement grout.
5. Fill the top 2 feet of the hole with lean concrete and set the terminal box and lockable cover in place flush with the surrounding ground surface. Fit the top of the standpipe with a vented screw plug.
6. After completion of installation, survey the as-built collar elevation to an accuracy of plus or minus 0.01-foot and its horizontal position to an accuracy of plus or minus 0.3-foot. Prepare a well log for the observation well in accordance with applicable regulations and as directed by the Engineer.

C. Before construction operations, demonstrate that each observation well is functioning properly by adding or removing water, measuring rates at which water levels fall and rise in standpipes, and comparing the final water levels with pre-test levels, in the presence of the Engineer.

D. During construction operations, periodically demonstrate continued proper functioning of each observation well by performing rising and falling head tests on the following anticipated schedule: Every 3 months plus whenever the monitoring personnel report an apparent problem with a specific instrument.

E. Protect and maintain observation wells in satisfactory working condition until completion of the Contract. Clean out all clogged wells by flushing with water or other suitable means.

3.06 INSTALLATION OF VIBRATING WIRE PIEZOMETERS

A. Vibrating wire piezometers shall be installed as specified herein. Piezometers shall be installed no closer than 10-feet horizontally to holes containing other instrumentation.

B. Bentonitic or polymer drilling mud shall not be used.

C. Take three split spoon samples for each piezometer installed. Samples shall be taken 5 and 10 feet above the planned installation depth and at the planned installation depth. For VWPZs installed in rock, split spoon samples shall be taken 4 and 10 feet above the planned installation depth and a rock core sample shall be taken throughout the bottom 5 feet.

D. Prior to insertion of the piezometer in the borehole, the piezometer and cavity between filter and diaphragm shall be saturated with clean water. Saturation shall be maintained throughout the installation.

E. The piezometer shall be lowered to the specified installation depth and allowed to achieve thermal equilibrium by waiting for a sufficient time as stated by the

manufacturer, and readings taken of piezometer pressure and temperature, and barometric pressure. Corrections shall be applied in accordance with factory calibration data. The actual water head over the piezometer diaphragm shall be determined by direct depth measurement. The calibration of the piezometer shall be checked by comparing the actual difference in water head with the difference between the piezometer readings. If the two values differ by more than 1.0-percent of the specified range of the piezometer, the piezometer shall be replaced by an identical instrument at no additional cost to the Authority. If the two values agree to within 1.0-percent of the specified range of the piezometer, the piezometer shall be installed and the elevation of the diaphragm shall be recorded.

F. Depth to the top of the increment of granular bentonite shall be checked using a cylindrical sounding hammer. The granular bentonite shall not be tamped.

G. After completion of installation, a post-installation acceptance test shall be performed to verify that the piezometer functions correctly.

H. After completion of installation, the as-built location in horizontal position shall be determined to an accuracy of plus or minus 1 foot, and the elevation of the top of the roadway box to an accuracy of plus or minus 0.01 foot. The elevation of the piezometer diaphragm shall also be determined to an accuracy of plus or minus 0.1 foot.

3.07 INSTALLATION OF MONITORING POINTS

A. Monitoring includes measurement of both horizontal and vertical movement of facilities. Monitoring points shall be installed at the locations shown on the Contract Drawings and as determined by Contractor in accordance with the Contract requirements. Column/building, abutment or wall movement points shall typically be installed into vertical surfaces of the pier column, abutment, wall or building. Drilled holes shall be located to avoid historically and architecturally significant design features of the structure. Holes for anchor sleeves shall be drilled into horizontal mortar joints where possible.

B. The bolt in structure monitoring points shall be kept permanently fixed in the anchor with thread-locking compound.

C. After completion of installation of a structure monitoring point, the as-built location in horizontal position shall be determined to an accuracy of plus or minus 0.3 foot, and the elevation to an accuracy of plus or minus 0.01 foot.

D. Surface settlement movement points shall be installed as shown and as follows:

1. Ground Surface and Rigid Pavement/Sidewalk (S1 and S2)
   a. Drive pipe to depth shown using a coupling and nipple as striking surface.
   b. Remove coupling and install pipe cap with read point.
   c. Excavate area around pipe and place curb terminal box. Backfill outside of box and leave box with cover locked.

E. Structure Monitoring Points (SM and SP):

1. Drill a hole of required diameter and depth.
2. Remove drilling debris from the hole by air or other suitable means.
3. Assemble the expansion anchor and insert it into the hole.
4. Tap outer sleeve onto wedge nut to achieve initial sleeve contact with wall of hole.

5. Expand outer sleeve into tight contact with wall of hole by turning bolt until anchor is rigid within the hole. Exercise care not to strip wedge nut threads by excessive turning of bolt.

6. Install optical survey prisms as shown and in accordance with the manufacturer's recommendations.

7. Placement

   a. Structural monitoring points (SM) on vertical surfaces consist of hemispherical head bolts. They shall be installed at all the locations shown on the Contract Drawings.

   b. Structural monitoring points (SP) on structures shown on Contract Drawings consist of support brackets equipped with precise optical prisms. The approximate locations are presented on the Contract Drawings. Exact locations shall be determined in the field by Contractor and approved by the Engineer.

3.08 INSTALLATION OF GRID CRACK GAUGES

A. Installation shall be in accordance with the manufacturer's recommendations.

B. After completion of installation, a post-installation acceptance test shall be performed to check that two parts of the gauge are free to move over each other by passing a feeler gauge or thin plastic card between the two sections.

C. After completion of installation, the as-built location shall be recorded.

D. Crack gages have been installed previously by the Authority on buildings and structures in which pre-construction surveys were prepared. Some of these existing crack gages, selected by the Engineer, shall be monitored by the Contractor. Locations of the existing crack gages to be monitored will be furnished by the Engineer.

3.09 INSTALLATION OF SEISMOGRAPHS

B. Seismographs are portable units to be deployed at vibration monitoring locations immediately before any vibration-producing activity. Geophones shall be firmly anchored to concrete, pavement, and rigid surfaces as shown in the Drawings. Drill and install "Red Head" Trubolt wedge anchors, "Red Head" Multi-set II drop-in anchors, or approved equal, at vibration monitoring locations.

C. Contractor shall install additional seismographs at vibration monitoring locations as directed by the Engineer to collect data. Vibration monitoring locations shall include points on the ground surface between 3 and 6 feet from the faces of bridge columns, abutments, walls or buildings. Seismograph and geophone shall be firmly mounted on the surface slab of concrete or asphalt, Geophone bolted into "Red Head" anchors set into surface where permissible.

D. Geophone placed in contact with undisturbed soil or rock shall be firmly mounted and attached to a flat rigid metal plate with spikes as per manufacturer recommendations. Geophone, metal plate, and seismograph shall not vibrate independent of the contact ground.

3.10 INSTALLATION OF AUTOMATED MOTORIZED TOTAL STATIONS

A. Installation shall be under the direction of the Automated Motorized Total Station Specialist who shall select the locations of the prisms and total stations, based on the locations shown on the Contract Drawings and as determined by Contractor in accordance with Contract requirements and as approved by the Engineer. These

locations shall take into account ambient conditions such as sight distances, lines of sight, vibration of structures, traffic, and pedestrian interference, and temperature diffraction effects. The locations of the reference prisms shall take into account the need for them to be outside the zone influenced by construction

B. Immediately after completion of installation of each total station and associated prisms, perform post-installation acceptance tests to ensure that the system is functioning correctly. Post-installation acceptance tests shall be made in accordance with the detailed step-by-step procedures that were submitted as specified elsewhere herein and as approved by the Engineer.

C. A baseline survey and as-built locations record shall be carried out by Contractor. Deep Benchmarks located within the Project right-of-way, but outside the probable zone of influence, shall be used for this purpose to the extent possible.

3.11 INSTALLATION OF BIAXIAL TILTMETERS

A. Tiltmeters shall be securely mounted to the structures using methods as recommended by the manufacturer, at the locations shown on the Contract Drawings and as determined by Contractor in accordance with Contract requirements. The sensitive axes of the tiltmeters shall be mounted perpendicular and parallel to the face of the structure.

B. Each tiltmeter or group of tiltmeters shall be cabled to a datalogger.

C. After tiltmeter installation, perform post-installation acceptance tests by reading the tiltmeter to ensure correct functioning.

D. After tiltmeter installation, the as-built location in vertical and horizontal position shall be determined to an accuracy of plus or minus 0.5-foot.

3.12 INSTALLATION OF THE CDM SYSTEM

A. Schedule work activities such that the CDM system, including primary and secondary servers are fully functional prior to the start of any excavation work to accommodate the collection of baseline data where required.

3.13 FIELD CALIBRATION AND MAINTENANCE

A. Contractor's instrumentation personnel shall conduct regular maintenance on all observation wells and piezometers components until instruments are no longer required for the collection of data for this Contract. Periodic testing and maintenance shall be as specified elsewhere herein for observation wells.

B. When using optical survey instruments for collecting data, perform an EDM calibration to determine the zero error and scale error on a calibration baseline that meets NGS standards (example Georgetown, Marlboro, etc.). The length of the calibration baseline shall span a range of distances that will be encountered during the Work. Before performing the calibration, check the adjustment of the tribrachs. The calibration shall be performed every six months, and the results applied to each distance measurement. Obtain an access permit from the appropriate agency, and make the necessary arrangements before any visit to a calibration baseline. When used for collecting data, Contractor's level shall be peg-tested, and adjusted if necessary once a week to check for collimation error.

C. Calibration and maintenance of the automated motorized total station systems shall be in accordance with the recommendations of the Automated Motorized Total Station Specialist.

D. Ensure that all instruments providing data for the Contract, remain functional to the end of construction.

E. Carry out maintenance in accordance with the plan approved by the Engineer.

F. When directed by the Engineer, using qualified instrumentation personnel, replace or repair instruments that are damaged or become non-functional. Failure to effect repair or replacement within 72 hours of notification of malfunction may result in the issuance of a stop work order by the Engineer. Furnish all materials associated with the repair of damaged readout units used in the performance of the instrumentation program, regardless of the nature of such damage

3.14 CALIBRATION, INSPECTION, AND MAINTENANCE OF MANUAL READOUT UNITS

A. Conduct regular inspections, calibrations, and maintenance of readout units. Calibrations shall be of two types: field calibrations to be made by Contractor, and factory calibrations to be made by the manufacturer. Field inspections and calibrations shall be documented on forms approved by the Engineer. The results of the field calibrations shall be submitted and the results of field inspections shall be filed, as specified elsewhere herein. All readout units shall be furnished and installed with a clearly visible sticker to indicate the dates of the previous and next calibrations. Maintenance shall be in accordance with the manufacturer's instructions and performed by Contractor.

B. Field calibrations of readout units shall be made by Contractor, on a frequency not exceeding three months, unless otherwise specified herein.

1. Field calibrations of observation well and piezometer readout units shall consist of checking the graduated cable against a standard traceable to the National Institute of Standards and Technology, to an accuracy of plus or minus 0.02 foot.
2. Field function checks and any appropriate calibrations of dataloggers shall be performed, using the manufacturer's standard procedures.

C. Factory calibrations of readout units shall be made by the instrument manufacturers as specified herein, on a frequency not exceeding one year. It shall be Contractor's responsibility to package and transmit the units to the manufacturer for the required calibrations, furnish insurance against loss or damage, and reimburse the manufacturer for the calibrations.

1. Factory calibrations of readout units for in-place tiltmeters shall be performed by the manufacturer, using the manufacturer's standard procedures, which, where applicable, shall be traceable to the National Institute of Standards and Technology.
2. Factory calibrations of seismograph vibration monitors shall be performed by the manufacturer, using a shake table and a reference sensor traceable to the National Institute of Standards and Technology. Factory calibrations of overpressure sensors shall be performed by the manufacturer using a calibrator traceable to the NIST.

D. Field inspections of readout units shall be made by Contractor, on a frequency not exceeding one week. Inspections shall consist of relevant items from the following list:

1. Examine readout units for evidence of damage, wear, and malfunction.
2. Bend cable back and forth, at points of connection to the reading unit and to a field terminal, while reading the instrument, to verify connection integrity.
3. Examine readout units for integrity of caps on connectors.
4. Check O-rings and other connection for proper fit.

E. Repair any damaged readout units used by Contractor in the performance of the instrumentation program at no additional cost to the Authority, regardless of the nature of such damage. When a readout unit has reached the end of its useful life as a result of normal wear and tear, it shall be replaced by Contractor at no additional cost to the Authority.

3.15 DATA COLLECTION

A. Collect appropriate data in accordance with the specified requirements, and agree with the Engineer on the validity of formal initial readings or baseline readings as defined herein. All subsequent readings shall be compared to the formal initial readings to determine levels of change.

B. Manually-read instruments shall be monitored by Contractor throughout the project duration, after formal initial readings have been completed. The following data collection schedule is a minimum requirement:

1. Once per month during the period between formal initial instruments readings and the point of time when any active construction will take place within a zone of 100 feet surrounding the plan location of the relevant instrument.
2. Once per day (minimum) during the period when any active construction will take place within a zone of 100 feet surrounding the plan location of the relevant instrument, or more frequently if Threshold Values are exceeded.
3. Once per week during the period of four weeks after:
   a. All active construction operations within a zone of 100 feet surrounding the plan location of the relevant instrument have been completed; and
   b. All monitoring reading data indicate stable conditions.
4. Once per month from the end of the period described herein above until the end of the construction of each bridge element and demolition of any existing structure elements.
5. Any new construction activity within a zone of 100 feet surrounding the plan location of the relevant instrument or any resumption of ground, surface or structure movement or groundwater level change requires the restart of the above procedure as applicable.

C. Anticipate collection of data from instruments automatically monitored by datalogger and modem at least:

1. Twice per day (every 12 hours) during the period between baseline readings and prior to start of construction activities within 100 feet surrounding the plan location of the relevant instruments.
2. Continuously for seismographs during the period when any active construction will take place within a zone of 100 feet surrounding the plan location of the relevant instrument.
3. Six (6) times per day (every 4 hours) for tiltmeters and vibrating wire piezometers during the period when any active construction will take place within a zone of 100 feet surrounding the plan location of the relevant instrument.
4. For Automated Motorized Total Stations prisms (SP) installed on existing buildings, walls and bridge elements, eight (8) times per day (every 3 hours) from one month before the construction approaches to within 100 feet of the buildings, walls and bridge elements until 3 months after construction is 100 feet past the buildings, walls and bridge elements.

D. After taking a manual reading, and prior to taking a reading on any other instrument, the reading shall be compared with the previous reading of that instrument. If the comparison indicates that changes are not typical of previous readings, the reading shall be repeated to determine whether it is erroneous or whether the second reading confirms the first.

E. After taking a reading, the reading shall be compared with the formal initial reading to determine whether a Response Value has been reached. Upon the reaching of a Response Value, the actions specified herein shall be taken.

F. While collecting data, Contractor technicians shall examine installed instrumentation for evidence of damage, malfunction, and possible future damage caused by construction or other activities and report any such issues to the GIE; the GIE shall then immediately inform the Engineer.

G. Provide to the Engineer access and, as required, assistance in accessing all instruments for observance of instrument reading at any time.

H. Collect appropriate data for the taking of formal initial readings or baseline and submit to the Engineer for agreement on the validity of such readings in the format provided by the Engineer. No instrument will be accepted or paid for until formal initial readings are agreed upon as specified herein.

I. Record data on field data records including, but not limited to, the following list. Record data in U.S. customary units such as feet, inches, pounds, etc.

1. Project name
2. Contract name and number
3. Instrument type
4. Date and time
5. Observer
6. Readout unit number
7. Instrument number
8. Readings
9. Remarks
10. Visual observations
11. Other causal data including weather, temperature, and construction activities

J. Collect data from instrumentation additional to that shown on the Contract Drawings which Contractor believes are required to ensure the safety of personnel and the Work. Such data will be accepted by the Engineer only if the data are collected and plotted in the specified format, if readout unit materials and calibrations are as specified herein, and if submitted to the Engineer within one month of data collection.

K. Provide and facilitate safe access to the Work at all times for the Engineer to observe the collection of data from specified instruments including existing instruments installed by others, and from any additional instruments installed by Contractor as specified. Safe access shall include, but not be limited to, cessation of work activities, temporary relocation of obstructing materials and equipment, provision of ladders, working platforms and hoisting services, and any other needs that, in the opinion of the Engineer, are necessary to ensure the safety of personnel. Furnish two sets of safety equipment for use by the Engineer when observing the collection of data including, but not limited to, safety harnesses.

L. The following paragraphs define formal initial readings that shall be collected by Contractor, and agreed on by the Engineer. A series of readings from which a formal initial reading is chosen shall be taken from each new instrument within a period of 15 minutes. Data collection after the establishment of formal initial readings shall be as described herein below.

M. A formal initial observation well reading shall consist of the reading that is closest to the average of three readings with the water level indicator. The indicator shall be removed from the standpipe between these three readings. Each reading other than the formal initial reading shall be a single reading with the water level indicator. Reading accuracy shall be plus or minus 0.05-foot.

N. Movement monitoring by manual surveying methods shall conform to the following requirements:

1. For vertical movement monitoring, perform runs by a single run beginning and ending on two different deep benchmarks. Use monitoring points as turning points or as intermediate foresights from two different turning points, allowing elevations to be adjusted and eliminating significant observational errors. The maximum length of line of sight shall be 230 feet, and the imbalance between backsight and foresight shall not exceed 30 feet. Allowable level loop misclosure shall not exceed plus or minus 0.033 times the square root of "M" feet (where "M" is the distance of the level run in miles) for a single run between two deep benchmarks. A formal initial reading on a movement monitoring point shall consist of the closest reading to the average of three elevations, from three independent level runs that meet the closure specified herein. Determine elevations established subsequent to a formal initial reading by a single run as specified herein. The least count (without estimation) of the rod and level combination shall read to 0.003 foot or less, such that the accuracy of an elevation measurement shall be plus or minus 0.01 foot (at 95 percent level of confidence).

2. For horizontal movement monitoring, if a theodolite is used, the direction measurements shall be made in two sets of direct and reverse pointings, changing the circle setting by 90-degrees between sets. Reduced directions shall be rejected if they deviate from the mean by more than 5 arc-seconds. Plumb the theodolite over the occupied point by a high precision optical plummet or mechanical centering device. When distances are measured with a tape, each distance shall be measured independently two separate times and shall be corrected for the temperature and tension of the tape. A formal initial reading on a movement monitoring point shall consist of the reading that is closest to the average of three readings, from three independent set-ups, each as specified herein. Each reading other than the formal initial reading shall consist of a single set of readings, as specified herein. All readings shall be referenced to stable horizontal control points. Reading accuracy shall be plus or minus 0.03 foot. Horizontal control points will be installed by others as shown on the Contract Drawings.

O. A formal initial reading of a crack gauge and also each subsequent reading shall be a single reading.

P. Collect seismograph ambient data before any vibration-producing construction activities to document background vibrations. In addition, monitor vibration during construction. Notify the Engineer at least 24 hours before starting a new vibration-producing task. Monitoring shall be as follows.

1. During all monitoring of vibration-producing construction activities, document all events that are responsible for the measured vibration levels and submit the document to the Engineer with the data.

Q. Baseline readings of Optical Survey Prisms (SP) measured by Total Stations shall consist of the average of readings taken four times a day for a period of 3 months prior to any construction. The readings shall be automatically corrected for self movement of the stations with network adjustment and the accuracy of the readings shall be plus or minus 0.100 inch for both vertical and horizontal position

R. Baseline readings of automated tilt sensors shall consist of the average of readings taken four times a day for a period of 3 months prior to any construction activities.

3.16 OPERATION OF THE CDM SYSTEM

A. Maintain all components of the CDM system in functional status for the duration of the Contract.

B. The Engineer reserves the right to order construction work to be suspended any time that the CDM system is not sufficiently functional to serve the needs of the Project as determined at the sole discretion of the Engineer. The Engineer will authorize restarting of the work once the CDM system has been restarted to a functional state as determined at the sole discretion of the Engineer. No additional compensation or extension of Contract time will be allowed due to this suspension.

C. The CDM system shall operate 24 hours per day, 7 days per week, for the duration of the Project and provide immediate access to all stored data for anyone given password access to the system.

3.17 REPORTING OF DATA

A. Real Time: The reporting tool displays aggregate data in real time by default. Real time is defined as time increments of no more than 5 minutes.

B. Archives: All data logged since the beginning of project shall be available for reporting.

C. All reports shall be generated by an authorized user via a web interface.

D. Report Types for real-time on-demand web based reporting.

1. System status: Shows any readings that exceed Response Values and any components of the CDM system that are not functioning correctly. Alert mechanism, based as appropriate on the Response Values defined herein, shall be furnished by Contractor for individual sensors and monitoring points as appropriate. The response values and the alert mechanism shall be programmed into the CDM computer as reviewed and approved by the Engineer.
2. Current readings: Shows the latest reading of all sensors, a group of sensors or a single sensor and their Alert Levels.
3. Single device over time: Shows data over time from a single device in the following formats:
   a. Line-graph
   b. Tabular data
4. Like devices over time: Shall show data from two or more like devices over time in the following formats:
   a. Line-graph

b. Tabular data

5. Unlike devices over time: Generates reports of devices of two different types over a period of time. Reports shall be viewable in either of the following formats:

a. Side-by side comparison of single devices of multiple types as Line-graph and/or Tabular data.

b. Side-by side comparison of multiple devices of multiple types as Line-graph and/or Tabular data.

6. Data for any device being polled by a datalogger shall be viewable in the following formats:

a. Single device over time

b. Like devices over time

c. Unlike devices over time

7. Failure Reporting

a. Device failure over time: A date/time listing of device failure for specific devices. Report shall include:

(1) Device Name

(2) Device Location

(3) Time within 5 minutes of recorded failure

E. Comments: The system shall also be able to provide on the above reports a summary of the daily and/or instrument specific comments over time.

F. Alert History

1. Current alert status: A single location within the user interface shall display a notification of the highest current active alert.

2. All alerts shall be logged and available for review when requested via the web interface for authorized users only. Alert History shall be viewable in the following formats:

a. Overall alerts: Summary report of all alerts logged for Project.

b. By device: Summary of all alerts logged for a particular device.

c. By multiple devices: Summary of all alerts for a user created selection of multiple devices.

d. By frequency: Summary report of alerts sorted by the frequency of the alert type.

e. During date/time range: Summary of all alerts for a specified date/time range.

G. Record Reports

1. The geotechnical instrumentation firm shall produce record reports in Adobe Acrobat format that are locked to prevent alteration.

2. All record reports shall be formatted to a printable version.

3. Data for all record reports shall be shown in appropriate engineering units, with meaningful scales and the appropriate number of significant digits.

4. The following record reports shall be submitted to the Engineer by Monday noon via email for all data recorded from Sunday 00:00 to Saturday 23:59.99 of the previous week:

a. Tabulation of any readings which exceeded Alert Levels showing the sensor number together with the reading, the Alert Level exceeded, the date and time of

the reading, and any relevant comment on construction activity that may be related to the exceedance.

b. Tabulation of any components of the CDM System that malfunctioned and a brief description of the current status of that component.

c. Tabulation of any unusual trends in the data for the prior week and any construction activities that might be related to those trends.

d. Graphs of historical data for groups of instruments with the grouping to be determined by Engineer.

e. Any corrections, changes and additions to a previous record report filed with the Engineer.

5. Record reports shall be maintained in an online database organized so that any historical report can be immediately identified and retrieved for the duration of the contract. At completion of the contract, a readable electronic copy of all record reports shall be submitted to the Engineer.

H. Data Export: The CDM System shall include the capability to export any data selected by the user into a comma-delineated and a XML format for import into other software applications.

I. All collected manual data shall be processed and made available on the CDM system website interface within 8 hours of collection time.

J. All data automatically monitored by datalogger and modem shall be processed and made available on the CDM system website interface within 2 hours of collection time.

3.18 ALERTING

A. General

1. Alerts shall be generated when data collected are determined to be reaching or exceeding the Threshold and Limiting Values as defined herein, or if significant components of the CDM System fail.

2. Alerts for Threshold and Limiting Levels shall initiate automatic messaging by email and pager to a pre-selected address list. The electronic message must contain the sensor that has exceeded its Response Level, the date and time of the reading, the reading value and the Response Level.

3. The alert system shall include a means for the recipient of the alert to acknowledge that the alert has been received and to disable repeated alarming on that sensor.

4. Each datalogger must be capable of being polled to update the CDM System database at an interval no larger than 5 minutes.

5. Each datalogger shall compare each sensor reading to its Threshold and Limiting Levels at an interval not to exceed 2 minutes. If the reading exceeds the Alert Level, the datalogger is to automatically notify the CDM System of the exceedence within 1 minute.

B. Data Collection: The automated monitoring system shall be programmed and re-programmable to recognize Response Levels and to respond as specified herein. The logging system shall operate as follows:

1. Normal Operation: The automated system shall measure all typical instrumentation data collected by datalogger at the scanning intervals as specified herein. Data shall be stored at a frequency no less than that specified herein.

2. Threshold and Limiting Values Exceeded: If an instrument output reaches or exceeds the programmed Response Value, the system shall automatically increase the frequency of measurement and/or recording for all associated instruments to an interval not to exceed one per 5 minutes. The increased measurement frequency shall continue until changed by the Engineer or until such time as the instrument(s) no longer exceeds the Response Level(s).

3. Automatic notification of contact personnel of any Response Level exceedence shall also as specified herein.

C. Alert Reporting and Notification

1. Notification

a. As specified herein and as established by Contractor for Contractor designed system, there shall be 2 Response Levels for each sensor, each having a specific alert action or actions associated with it.

b. Alert action must generate a voice and text prompt over phone and pager.

c. Alert action must be able to generate an e-mail notification.

d. Alert actions must be configurable for each Response Level.

2. Connectivity: Alerts shall be generated if any component of the polling and response system loses connectivity.

3. Administration

a. The Alert reporting system shall have an administrative interface to allow adding and removing of alert notification recipients by phone, e-mail and pager.

b. The Alert reporting system shall have an administrative interface to allow authorized users to specify criteria for Alert generation.

3.19 LOSS OF OR DAMAGE TO INSTRUMENTATION

A. Protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations, weather, traffic, and vandalism.

B. If an instrument, including an existing instrument installed by others, is damaged or inoperative, Contractor's instrumentation personnel shall repair or replace the damaged or inoperative instrument within 72 hours. Where damage or improper function is due to Contractor's actions, including purchase of defective equipment, Contractor shall be responsible for repair or replacement. Notify the Engineer at least 24 hours before repairing or replacing a damaged or inoperative instrument.

3.20 DISCLOSURE OF DATA

A. Do not disclose any instrumentation data to third parties other than those approved by the Engineer and do not publish data without prior written consent of the Authority.

3.21 RESPONSE ACTION LEVELS

A. Threshold Response: Measurement of displacements or vibrations reaching maximum allowable Threshold Values shall trigger the mandatory evaluation by Contractor and the Engineer of current construction methodology and if necessary, implementation of mitigating action to avoid detrimental effect on the surrounding facilities and groundwater regime. Continuation of the Work in the area of concern shall be allowed only at the sole discretion of the Engineer. Upon reaching or exceeding the Threshold,

Contractor shall immediately undertake the measures defined in the Response Action Plan and shall implement all necessary steps so that the Limiting values are not reached.

B. Limiting Response: Measurement of displacements or vibrations reaching allowable Limiting Values shall trigger the mandatory cessation of Work in the area of concern and will immediately require implementation of all necessary mitigating action(s) to prevent damages to surrounding facilities and changes to the groundwater regime, as defined in the accepted Contractor's Response Action Plan.

3.22 RESPONSE ACTION PLANS

A. The Response Action Plan shall identify the specific anticipated actions or example actions to be implemented at each response action level for each element of the Work which may cause movement to reach the response action levels and shall include as a minimum the measures described above under Response Action Levels, all other potential response measures envisioned by Contractor, plus the names of the responsible person of Contractor's team for each element of the Work. The Response Action Plan, as a minimum, shall also identify all key structures and utilities throughout the Site and their owners and responsible contact persons, as well as define Contractor team person responsible for each structure. The Response Action Plan shall also identify the resources required for each Threshold response and Limiting response, including the notification required if action is taken at each level.

B. If required, jacking and leveling of existing bridge and other structures shall be performed in accordance with requirements shown on the Contract Drawings, or as directed by the Engineer.

C. The Response Action Plan shall be updated by Contractor from time to time as required by the Engineer based upon performance in field and changes in responsible persons as the project proceeds.

D. At a minimum, one copy of the Response Action Plan shall be maintained present at Contractor's Office. The Response Action Plan shall be distributed to the Engineer.

3.23 ADDITIONAL GEOTECHNICAL INSTRUMENTATION

A. Design and install instruments that are not included in the Contract Drawings and that are deemed necessary by the Contractor to ensure safety of the personnel and the Work. Install all geotechnical and structural instrumentation required to monitor the Works and actual effects, if any, on existing structures as specified herein and as shown on the Contract Drawings.

B. Threshold and Limiting response values for each additional instrument shall be based on the criteria shown on the Contract Drawings, the location of the instrument relative to the Works, and as specified herein.

C. In addition to Vibration Monitoring (VM) Locations shown in Contract Drawings, provide additional VM locations for monitoring the existing bridge during construction as directed by the Engineer. Locations of the VM shall be determined by the Engineer.

D. Monitoring and reporting of additional instrumentation data shall be as specified herein.

3.24 INTERPRETATION OF DATA

A. Contractor's interpretation of the collected data shall include making correlations between instrumentation data and specific construction activities. Instrumentation data shall be evaluated to determine whether the response to construction activities is in

agreement with predictions. Interpretations shall be submitted in writing to the Engineer within 12 hours of reduced data being available on the Project Intranet if the data do not indicate a problem. If a problem is indicated, this time shall be reduced to 6 hours.

B. The Geotechnical Instrumentation Engineer shall interpret the data on a continual basis in sufficient detail to identify spurious instrument readings and ensure they do not mistakenly result in the issuance of alerts that cause unnecessary actions to be undertaken.

3.25 IMPLEMENTATION OF RESPONSE ACTION PLANS

A. If Threshold Value is reached:

1. Meet with the Engineer to discuss the need for response action(s) in accordance with Contractor's Response Action Plan. Contractor's qualified instrumentation personnel shall attend as necessary, including subcontractor specialists such as for AMTS. Participation may be through conference calls if specialists cannot be available in person, but all participants shall be aware of relevant instrument readings and their interpretations.
2. Within 24 hours of determining that a Threshold Value has been reached, submit a detailed specific plan of action, based as appropriate on Contractor's Response Action Plan submitted previously.
3. Implement response action(s) within 24 hours of submitting a detailed specific plan of action, so that the Limiting Value is not reached.
4. Install additional instruments if they are needed to further define the magnitude of the indicated problem.
5. Take all necessary steps so that the Limiting Value is not reached. Contractor may be required by the Engineer to suspend activities in the affected area with the exception of those actions necessary to avoid reaching the Limiting Value.

B. If a Limiting Value is reached:

1. Stop work and meet with the Engineer to discuss the need for response action(s). Contractor's qualified instrumentation personnel shall attend as necessary, including subcontractor specialists such as for AMTS. Participation may be through conference calls if specialists cannot be available in person, but all participants shall be aware of relevant instrument readings and their interpretations.
2. Within 24 hours determining that a Limiting Value has been reached, submit a detailed specific plan of action, based as appropriate on the generalized plan of action submitted previously.
3. Implement response action(s) within 24 hours of submitting a detailed specific plan of action, so that the Limiting Value is not exceeded.
4. Install additional instruments if they are needed to further define the magnitude of the indicated problem.

3.26 DISPOSITION OF INSTRUMENTS

A. Remove all instruments at the end of the Contract with the exception of those to be retained as directed by the Engineer. For instruments installed in pavement or the ground, the upper 2 feet of the instrument shall be removed, together with the ground surface protection. The remaining open portions of the instrument and casing shall be backfilled with cement grout up to a level 2 feet below the ground surface, and with lean concrete in the upper 2 feet. New pavement patches shall be constructed, in paved areas,

of the same material and to the same thickness as existing adjacent pavement. Disturbed or damaged surfaces shall be restored to the condition existing before installation of the instrument. If directed by the Engineer, remove and dispose of those portions of instruments constituting an obstruction, including deep benchmarks, observation wells, piezometers, settlement monitoring points, and survey targets

B. Portable readout units used by Contractor during installation, during pre- and post-installation acceptance testing, and for collecting data shall become the property of Contractor.

C. Before shutting down the CDM system, submit a complete electronic record of all instrumentation readings as required by the Contract.

D. All salvaged instruments shall become the property of Contractor.

E. To the extent practicable, where instruments have to be removed from floors, walls, ceilings, facades or support columns to preserve the appearance of the instrumented structure, restore the surface to its original condition to the satisfaction of the property owner and/or the Engineer by use of solvents, infilling, spackling, polishing, painting or replacement.

END OF SECTION

SECTION 02212

GEOTECHNICAL INSTRUMENTATION AND MONITORING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. At least 30 days before beginning any construction, submit for the Engineer's approval generalized plans of action to be implemented in case any Response Value as specified elsewhere herein is reached. The generalized plans of action shall be positive measures by Contractor to do any or all of the following, as applicable.

1. Limit further construction-induced structure and ground movement.
2. Limit further decrease in groundwater and piezometric levels.
3. Control vibrations.
4. Maintain the structural integrity of adjacent structures and utilities.
5. Install and monitor additional instrumentation.
6. Implement corrective, mitigative actions as defined on the Contract Drawings and including changing means and methods of construction as necessary.

B. Within 21 days after the Notice of Award, submit the following to the Engineer:

1. Proposed geotechnical instrumentation firm and qualifications, including resumes of Geotechnical Instrumentation Engineer, Instrumentation Superintendent, IT Engineer, and AMTS Specialist, sufficient to define details of relevant site experience requirements specified herein.
2. Resumes of other field and office geotechnical instrumentation personnel to be assigned to the project, other than clerical staff.

C. Within 60 days of Notice of Award, submit to the Engineer:

1. Layout plans and details of installation for AMTS systems based on the conceptual layout in Contract Drawings and actual field verification of same.
2. Schematic drawings showing physical locations of all components of the CDM system.
3. Flow charts illustrating the scheme for data flow within the CDM system.
4. Parts list that identifies model and quantity of each significant component and piece of software of the CDM system.
5. Proposed installation procedures and testing for each significant component of the CDM system.

D. At least 60 days before commencing installation of the first of each type of instrument, submit to the Engineer for approval the following items pertaining to that instrument type:

1. Detailed step-by-step procedure for installation, together with a sample installation record sheet (form). The procedures shall be bound and indexed. The installation procedures shall include appropriate content from the following list:

a. The method of forming boreholes, including the procedure for advancing casing, shall be submitted to the Engineer for review before commencement of the work.

b. The method to be used for cleaning the inside of casing or hollow-stem augers, and for disposing of drill water and cuttings.

c. Specifications for proposed grout mixes, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.

d. Drill casing or type and size of drilling tools.

e. Depth increments for backfilling boreholes with sand and granular bentonite.

f. Locations of IDS units and data loggers for tiltmeters, indicating which instruments are to be connected to their own individual datalogger, and which are to be grouped and connected to a common datalogger.

g. Method for overcoming buoyancy of instrumentation components during grouting

h. Method of sealing joints in pipes to prevent ingress of grout

i. Method for conducting post-installation acceptance test

j. Method for protecting instruments from damage

k. For AMTS monitoring systems, drawings showing final layout and design, support, installation details, wiring diagrams, conduits, cables, and power and communications requirements.

l. For AMTS, the algorithm used to calculate displacement as measured by the systems, and samples of AMTS data presentation.

m. For seismographs, method for mounting seismograph on rock, pavement, and soil.

n. Plans for equipment primary electrical power, back-up power, and telephone lines for data transmittal.

E. Prior to acceptance of the completion of installation of the CDM system, submit the following to the Engineer:

1. Documentation showing that all required functions of the CDM system have been demonstrated to operate satisfactorily.

2. As-built drawings showing the locations and identification of each component of the system

3. Flow chart illustrating the logic flow for the system

4. Written training document for first time users of the CDM system web interface

5. Samples of each type of report available on the system

F. For each time that the CDM system is unable to provide information on an unscheduled basis for more than 1 hour, submit a written explanation of the nature of the malfunction, the required repairs, and the steps taken to avoid a repeat of the malfunction.

1. If Contractor collects data using optical survey methods, the detailed step-by-step procedures for conducting all optical survey measurements to the specified accuracies shall include types of surveying instruments, all as specified herein, and data reduction procedures. The manufacturer's stated accuracy and the field procedures shall be such that the resulting accuracies meet the specified accuracies at a minimum 95-percent level of confidence.

2. Submit resumes of the Land Surveyor, field survey party chief, and surveyors.

3. A bar chart indicating the proposed schedule of instrument installation.

G. At least 30 days before purchase, submit to the Engineer manufacturer's product data describing all specified instruments including requests for consideration of substitutions, if any, together with product data and instruction manuals for requested substitutions.

1. Product data for the AMTS system shall include documentation to indicate that it has been proven to have the performance and precision specified herein for monitoring the deformation of structures other than tunnels at a minimum of one project.

H. Instrument Maintenance

1. Submit information pertinent to the maintenance requirements of the instruments proposed.
2. The information shall include, but not be limited to, frequency and duration of maintenance and required roadway outages and traffic interruptions as well as equipment and spare parts required for performing the maintenance.
3. Submit outline maintenance plan for the monitoring instruments proposed within three weeks of receiving Notice of Award.
4. At least 60 days before installation of any first instrument, submit detailed maintenance plan for all instruments of that type proposed to be installed.

I. Submit proposed power sources and layouts of power and signal cables for all instruments.

J. Submit proposed wireless methods of signal transmission.

K. Within ten workdays of installing each instrument, submit for review the installation record sheet for that instrument, including the as-built instrument coordinates as specified.

L. Submit soil and rock samples as specified herein.

M. Every four weeks submit to the Engineer updated as-built instrument location plans unless no instruments were installed since the last post-installation acceptance test.

N. Submit acceptance readings as specified herein comprising a minimum of three consistent readings taken at least one day apart before subject to any effects from construction.

O. Within ten workdays of receipt of each instrument at the site, submit a copy of factory calibration, manufacturer's test equipment certification, completed copy of quality assurance checklist, and warranty for each portable readout unit.

P. Within ten workdays of receipt of each instrument at the site, submit for review completed pre-installation acceptance test record form for that instrument.

Q. Within two workdays of each instrument installation, submit for review completed post-installation acceptance test record form for that instrument.

R. Submit all data and reports as specified herein including interpretive and alert reports.

END OF APPENDIX "A"

DIVISION 2

SECTION 02221

EXCAVATION, BACKFILLING AND FILLING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for excavation, backfilling and filling for purposes other than for the construction of the Mechanically Stabilized (MSE) Walls. MSE Wall construction including material, placement and compaction requirements for the select backfill and retained backfill shall conform to requirements shown on the Contract Drawings and in Specification Section 02485.

B. Definitions

1. As used herein, excavation shall mean the removal of existing pavement, concrete foundations and all materials other than bedrock (ledge rock) encountered within the limits of excavation that are not specified to be removed under the Section entitled "CUTTING, PATCHING AND REMOVAL".
2. As used herein, backfilling shall mean the filling of excavations made for construction purposes and shall extend only to existing grades or design grades, whichever are lower.
3. As used herein, filling shall mean the placement of fill material in conformance with requirements of this Section at or above existing grade or design grade, whichever is lower.

1.02 REFERENCES

American Society for Testing and Materials (ASTM)

ASTM D422	Standard Test Method for Particle - Size Analysis of Soils
ASTM D1556	Standard Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

New Jersey Interagency Engineering Committee (NJIEC)

Standard Soil Aggregate Gradations

1.03 JOB CONDITIONS

A. Protect excavations as follows:

1. Prevent water from entering excavated areas and, if it does, remove it immediately to maintain a dry condition at all times.
2. Dispose of water in a manner not to cause injury to the public health or damage to public or private property.
3. If water enters excavated areas and weakens or disturbs underlying soil, remove the weakened or disturbed soil and replace it in conformance with 3.02 A.5.
4. Where shown on the Contract Drawings or where required for protection of adjacent utilities or structures or where required for performance of the Work, secure the sides of excavations against movement as follows:
   a. Furnish and install sheet piling or sheeting held in place by waling and bracing members. Top of sheeting shall extend at least six inches above ground or as shown on the Contract Drawings.
   b. Do not excavate below the bottom of sheet piling or sheeting.
   c. Fill voids behind sheeting immediately with material conforming to I-12 designation defined in 2.01 A.1 or otherwise approved by the Engineer.
   d. Comply with all other provisions of the Specifications and Contract Drawings that may impose additional or stricter requirements.
5. For excavations extending to a depth of 5 feet or more, and where sheeting is not required to conform with provisions of 1.03 A.4 above, excavate slopes to a safe angle of repose, or protect trench excavations by use of a portable trench shield.
6. Restore all areas impacted by excavation to their original condition, matching pavement types and sections to meet original pavement grades.

B. Do not traverse paved areas with tracked vehicles or equipment such as carry-all scrapers which may damage such pavement unless protected to the satisfaction of the Engineer.

C. Do not place fill or backfill on frozen subgrade.

D. Do not perform rolling or other compaction at any time when the ground water level is above a plane two feet below the surface to be compacted. When the ground water level is above such plane, lower it by approved methods and maintain it below such level prior to and during the compaction operations.

E. Protect from damage trees and other vegetation that are to remain in place.

1.04 RELATED SECTIONS

A. Section 02050 – Demolition and Disposal

B. Section 02051 – Approach Structure Demolition and Disposal

C. Section 02145 – Dewatering

D. Section 02110 – Excavation, Staging, Handling, Transportation, and Disposal of Hazardous Materials for the West First Street Site In Bayonne, New Jersey

E. Section 02112 – Excavation, Staging, Handling, Transportation, and Disposal of Non-Hazardous Materials for the West First Street Site In Bayonne, New Jersey

F. Section 02260 – Special Excavation Requirements

G. Section 02892 – Handling Treatment and Disposal of Non-Hazardous Soil Materials (NJ)

H. Section 02894 – Handling Treatment and Disposal of Non-Hazardous Soil Materials (NY)

I. Section 02895 –Disposal of Hazardous Materials

J. Section 02897 – Contaminated Materials Management

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Fill

1. Unless otherwise shown on the Contract Drawings, fill shall consist of clean sand and gravel containing no organic or miscellaneous matter, conforming to the following NJIEC Standard Soil Aggregate Gradations, except that, in lieu of the standard gradation given below, up to 10 percent passing the No. 200 sieve will be acceptable as I-12:

	Total Percent Passing by Weight NJIEC Designation		
	I-7	I-10	I-12
Sieve Sizes			
4 inch		100	100
2 inch		80-100	
1 inch	100		
3/4 inch		60-100	70-100
1/2 inch	80-100		
No. 4		40-100	
No. 8	35-100		
No. 16	25-90	20-70	
No. 50	5-50	5-40	0-75
No. 100	0-8	0-30	
No. 200	0-2	0-20	0-5

2. The Contract Drawings show which fill designations are to be used and the locations at which each designation of fill is required.

B. Backfill

1. Unless otherwise shown on the Contract Drawings, material shall conform to the requirements for I-12 designation.

C. Sources

1. Unless otherwise approved in writing by the Engineer, material excavated at the construction site shall not be used for backfill. Disposal of excavated material shall be performed in accordance with the General Notes on the Contract Drawings, as well as relevant sections of the Contract Specifications.

2. The Contractor shall furnish material from sources off site. The Contractor will be reimbursed only for the cost of furnishing backfill material from sources off site at the "Net Cost" for such Work. "Net Cost" shall be as described in section 3.05. The cost of placing and compacting the backfill shall be included in the contract bid price.

D. Recycled Concrete Aggregate (RCA) and Non-Clean Fill
RCA and Non-Clean Fill conforming to the requirements given below and to the gradations given in 2.01A.1 may be used as fill or backfill.

1. The RCA shall consist of at least 90 percent, by weight, Portland cement concrete, with the following materials making up the remaining 10 percent:

   Wood-0.1%, maximum
   Brick, Mica schist, or other friable material-4%, maximum
   Asphalt Concrete-10%, maximum

2. Virgin aggregate may be added to meet the 90% minimum concrete requirement.

3. The percentage of asphalt concrete and other deleterious material shall be determined by weighing that material retained on the no. 4 sieve, and dividing by the total weight of RCA material retained on the no. 4 sieve.

4. The Contractor shall submit to the Engineer a "Certificate of Clean Fill" for all imported fill material.

5. RCA proposed by the Contractor shall be from permitted or State registered Construction and Demolition Debris Processing Facilities (C&DDPF). The Contractor shall obtain and submit a copy of the permit or registration to the Engineer.

6. In New York, the source of RCA shall be C&DDPF conforming to 6 NYSRR Part 360-16: Construction and Demolition Debris Processing Facilities. In New Jersey, the source of the RCA shall be a Class B C&DDPF conforming to NJAC – Title 7: Environmental Protection, Chapter 26A, Recycling Rules.

7. For other imported fill material that does not have a "Certificate of Clean Fill", the Contractor shall submit a State Beneficial Use Determination of Reuse approval. In New York, the approval shall conform to 6 NYSRR Part 360-1.15: Beneficial Use. In New Jersey, the approval shall conform to NJAC 7:26-1.7: Exemption From Solid Waste Facility Permitting.

PART 3 EXECUTION

3.01 PREPARATION

A. Clearing and Grubbing

Remove trees, clear and grub areas to be excavated or in which construction is to be performed, as follows:

1. Remove trees, stumps, all roots larger than 2 inches in diameter, and all matted root systems.
2. Remove all topsoil, debris, organic matter and any other objectionable material not suitable for use as backfill or fill or for support of structures or pavements.
3. Backfill all holes and other low spots resulting from clearing and grubbing with material conforming with 2.01 B or 2.01 D before proceeding with compaction of fill as specified in 3.03 or with other construction in the area.

3.02 EXCAVATION

A. General

1. Excavation shall consist of the removal of materials as defined in 1.01 B.1, and the removed materials shall be stockpiled in accordance with the requirements shown on the Contract Drawings and Contract Specifications.

2. When excavation of bedrock (ledge rock) is required as shown on the Contract Drawings, the provisions for removal are shown on the Contract Drawings.

3. Excavate to elevations required for installation of permanent construction in such manner as not to disturb the subgrade below such elevations.

4. Where existing foundations or other existing construction are encountered which may cause hard spots, remove them to a minimum of two feet below subgrade for pavement or structures and backfill with material conforming with 2.01 B.

5. Should the bottom of excavation be weakened or disturbed or carried below required depth:

   a. Under footings - compact bottom, as specified in 3.03 below and replace over-excavation with concrete of the same Class and Type as that specified for the footing or foundation.

   b. Elsewhere - Compact bottom as approved by the Engineer and refill with material conforming with 2.01 B or 2.01 D.

6. Perform excavation around and adjacent to existing structures, pipes and conduits which are to remain in place, without damage to or movement of existing construction. Use hand excavation to locate and expose near-surface structures, pipes and conduits. When excavation is to be performed under such structures, pipes and conduits, support them in a manner as approved by the Engineer to ensure uninterrupted operation of the supported items

B. Dewatering

1. Dewatering shall conform to the requirements of Specification Section 02145.

2. Where excavations are to extend below the water table, prior to placement of any permanent construction or filling or backfilling any excavated area, lower the water table in such an area to two feet below the elevation of the required subgrade and maintain this condition until the construction or pavement is placed thereon.

3. Dewater in a manner to prevent the loss of ground due to the migration of soil fines into the dewatering system.

C. Trenching for Utilities

1. Shape bottom of trench to uniform invert section.

2. Conform with requirements shown on Contract Drawings for excavation support to prevent lateral movement or bottom heave.

D. Disposal of Excavated Material

Disposal of excavated material shall be in accordance with the General Notes on the Contract Drawings and the Contract Specifications. See Division 1 contract requirements for the recycling of construction debris material.

E. Restrictions

1. Do not place backfill until the Engineer has inspected and approved the Work and indicated where backfill may be placed.
2. Leave all pipe joints exposed until all tests on such pipe, required by other Sections of the Specifications, have been performed.
3. Remove all temporary structures, sheet piles, sheeting, bracing and forms and all organic materials and debris of every nature, taking care, upon the removal of sheet piling, sheeting and temporary supports, not to cause movement of adjacent ground or structures or create the danger of a slide.

3.03 PLACEMENT AND COMPACTION

A. Equipment

1. Steel vibratory rollers shall have provision for regulation of vibration frequency. The Engineer shall be informed of the type and size of equipment to be used before the start of any compaction efforts.
2. Placement and spreading equipment shall be reviewed and approved by the Engineer.
3. Unless otherwise shown on the Contract Drawings, pneumatic-tired rollers shall have minimum weight of 20 tons and a tire pressure of between 60 and 150 psi as directed by the Engineer. For aircraft pavements, the minimum roller weight shall be 50 tons.
4. When mechanical tampers are to be used, the Engineer shall be informed of the type and size for approval before compaction efforts with this equipment can begin.

B. Subgrade, Excavated and Existing Surfaces

Compaction of subgrade, excavated and existing surfaces will consist of a proofrolling operation performed as follows:

1. Compact surface with a minimum of six passes of an approved vibratory steel roller operated at a speed not to exceed three miles per hour and at the optimum operating frequency recommended by the manufacturer. Overlap passes of roller a minimum of six inches.
2. In areas where surface consists of a fine grained soil, compact with a minimum of six passes of an approved pneumatic-tired roller. Overlap passes of roller a minimum of six inches.
3. In areas where use of a roller is impractical, compact surface while at or near optimum moisture content with mechanical tampers.
4. If, in the sole determination of the Engineer, the proofrolling produces noticeable weaving of the surface, excavation of unsuitable material may be required below subgrade, within the limits and to the depth ordered by the Engineer.
5. In no case will the depth of such removal of unsuitable material exceed three feet below the subgrade.
6. Remove all such unsuitable material and replace it with suitable backfill material in accordance with the requirements of 2.01 B or 2.01 D.
7. The Contractor will be reimbursed for any ordered excavation of unsuitable material below the elevation of subgrade or under footings and subsequent backfilling at the "Net Cost" for such Work. "Net Cost" shall be as described in 3.05

C. Backfill and Fill

1. Moisture content of backfill and fill material shall be within a range of plus or minus two percent of optimum, as determined by Procedure C of ASTM D1557. This test shall be performed once every 4,000 cubic yards minimum.
2. Backfill and fill shall be compacted to achieve a density of 95 percent of the maximum density as determined by Procedure C of ASTM D1557, except where alternate density requirements are approved by the Engineer or shown on the Contract Drawings.
3. Backfill, conforming with I-12 gradation, and fill, conforming with I-7 and I-12 gradation, shall be placed in 14-inch, loose layers. In areas where a 14-inch layer over existing material is not adequate to support the construction equipment, increase thickness of first lift as approved by the Engineer.
4. When shown on the Contract Drawings, backfill and fill, conforming to I-10 gradation, shall be placed in 12-inch, loose layers.
5. In areas adjacent to structures and utilities, compaction equipment shall be restricted and as directed by the Engineer.
6. In areas where use of a roller is impractical, place fill in maximum 8-inch, loose layers and compact with approved mechanical tampers to the specified density. In pipe trenches, each layer of backfill shall be not more than eight inches in thickness before compaction. Place backfill on both sides of the pipe, simultaneously.
7. The surface of filled or backfilled areas, which are to receive pavement or on which a structure is to be placed, shall be within plus or minus 1/2 inch of the elevations shown on the Contract Drawings and shall be free of depressions or projections greater than 1/2 inch when tested with a 16-foot straight edge.
8. The surface of filled areas at other locations shall be within plus or minus one inch of elevations shown on the Contract Drawings unless a closer tolerance is necessary to meet requirements of other Sections of the Specifications or the Contract Drawings.

3.04 FIELD TESTS

A. Inspection and Testing

1. The Engineer will test delivered field samples of material submitted from each source, for conformance with section 2.01. Gradation and maximum density will be determined a minimum of once every 4,000 cubic yards in accordance with ASTM C117, C136, and D422 for gradation and Procedure C of ASTM D1557 for density. If deemed appropriate by the Engineer, Atterberg Limits will be determined on fine-grained soils in accordance with ASTM D4318.
   A. The Contractor must notify the Engineer when backfill and fill material are on-site at least seven days prior to its placement. This will allow the Engineer sufficient time to complete the required testing.
   B. If the Engineer's maximum density will be used for QC testing, the Contractor must first obtain this laboratory value from the Engineer prior to placement.
2. If the sample from a source is approved and if the Engineer requests, conduct the Engineer's representative to that source. Additional samples will be selected and tested.
3. The Engineer will notify the Contractor of approval of material source within seven days after receiving samples. Approval of a source of backfill or fill material shall be subject to material continuing to meet the requirements of 2.01.

4. The Engineer will check conformance to elevations shown on the Contract Drawings and required tolerance for surface straightness.
5. Provide labor and equipment to take samples as directed and to assist the Engineer in other tests.

B. Testing Requirements for Fill and Backfill

Testing will include control tests by the Engineer, quality control testing by the Contractor, and quality assurance testing by the Engineer.
Testing frequencies are function of the type of fill or backfill and the nature and size of the installation. The structural significance of the installation shall also be considered. In general, the frequency of both laboratory and field testing must increase as the material variability and structural importance goes up.

Suggested minimum testing frequencies are as follows:

Case I: Dedicated Stockpiles	
Moisture-Density/Proctor Test (D1557)	1 test/4,000 cu. yards of stockpile
Gradation (D422)	1 test/4,000 cu. yards of stockpile
Case II: In-Situ Testing – Per Lift	
Moisture-Density/Proctor Test (D1557)	1 test/10,000 sq. yards
Gradation (D422)	1 test/10,000 cu. yards
In-Place Density	minimum of 1 test/2,500 sq. ft.

1. Control Tests

   Fill and backfill material field samples will be tested in the laboratory by the Engineer at the frequency shown on the Contract Drawings. These control tests consist of determining maximum density and optimum water content by Procedure C of ASTM D1557, and gradation by ASTM D422. When deemed appropriate by the Engineer, Atterberg Limits will be determined on fine-grained soils in accordance with ASTM D4318.

2. Quality Control

   a. Provide and maintain quality control plans and procedures that shall ensure all fill and backfill materials and completed construction conform to this Section. The Engineer shall be afforded access to the Contractor's plant, equipment and field operations at all times for checking compliance with the approved quality control procedures. Provide labor and equipment to take samples as directed and assist the Engineer in other tests. Repair all areas from which samples are taken to meet all requirements of this Section.

   b. Quality Control consisting of in-place density testing shall be performed by the Contractor to determine densities achieved after compaction efforts.

   c. The quality control plan shall include as a minimum:

      (1) Assignment of quality control responsibility to specifically-named individuals.

      (2) Outline of sampling location procedures and in-place density testing methodologies and frequencies.

(3) Performance of regularly scheduled inspections of the material source in the case of RCA.

(4) Provisions for the prompt implementation of control and corrective measures.

(5) Provisions for liaison with the Engineer at all times

(6) Performance of necessary quality control tests, including use of a nuclear gauge.

(7) Description of equipment type, calibration and maintenance; operator identity and qualifications.

d. For RCA, Quality Control procedures shall include, in addition to that required under 3.04 B.2 b, performing the following tests on dedicated stockpiles being produced for use under this Contract:

(1) Gradation tests (ASTM C117 and C136) shall be performed at least once per day.

(2) Composition tests shall be a continuous visual inspection and shall include removal of any objectionable material to ensure compliance with 2.01B.

(3) Soundness of Aggregates (ASTM C88) and Resistance to Degradation (ASTM C131) shall be performed a minimum of once every two weeks, unless otherwise directed by the Engineer.

3. Quality Assurance Testing

a. Quality Assurance testing to verify field densities will be performed by the Engineer after compaction operations, at the frequencies shown on the Contract Drawings. Test methods may be either sand-cone (ASTM D1556), rubber balloon (ASTM D2167), or nuclear device (ASTM D2922), with moisture content for nuclear method determined by ASTM D3017. Tests will measure the density of the layer immediately below each compacted layer and the density of the uppermost or final layer. In-place density readings will be taken once per lift per 2,500 square feet.

b. Quality Assurance testing will also include periodic sampling and testing of backfill and fill materials to verify continued conformance with the requirements of section 2.01 and to verify the value of maximum density used as the control value, as per section 3.04 B.3d.

c. When performing Quality Assurance testing, the Engineer will determine the density of compacted fill or backfill by in-place density tests or from undisturbed samples cut from the compacted fill or backfill as required. Notify the Engineer 72 hours prior to start of filling or backfilling to allow the Engineer time to make provisions for such testing.

d. To evaluate whether material has been compacted to specified density the Engineer will compare results of in-place density tests with results of control tests on material of the same designation using Procedure C of ASTM D1557.

e. If fill or backfill have not been sufficiently compacted as determined by in-place density tests, the compaction effort shall be continued and moisture content shall be adjusted as necessary until the specified compaction is obtained.

3.05 "Net Cost" shall be computed in the same manner as is compensation for Extra Work, including any percentage addition to cost, as set forth in the clause of the Contract providing compensation for Extra Work. Performance of such Net Cost Work shall be subject to all provisions of the Contract relating to performance of Extra Work. Compensation for said

Net Cost Work shall not be charged against the total amount of compensation authorized for Extra Work.

END OF SECTION

SECTION 02221

EXCAVATION, BACKFILLING AND FILLING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Submit to the Manager, Materials Engineering Division, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, N.J. 07310-1397, proposed material suppliers and sources for each designation of fill or backfill to be used under this contract. The submittal document must contain, as minimum information, the Contract location, title and number; designation of intended material use; source and supplier of material being submitted. Sample submittal paperwork must be received by the Manager of Materials at least three weeks prior to delivery of material to site. Do not deliver any material until the Engineer has checked and approved material supplier and source. Delivered material must receive on-site approval as per Section 3.04, Paragraph A, prior to use.

B. The Contractor shall be responsible for Quality Control procedures. Before the actual start of earth work, the Contractor must submit a Quality Control Plan for review and approval by the Engineer.

C. Where sheet piling or sheeting is required as shown on the Contract Drawings, submit detailed Shop Drawings and design calculations of the sheeting and bracing system to the Engineer for review in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS. Submit such drawings and calculations three weeks prior to commencement of such excavation. Shop Drawings and calculations shall be prepared by a Professional Engineer, licensed in the State in which the work will be performed, who has a minimum of five years experience in the design of soil retaining structures. The Shop Drawings shall be sealed and signed by the Professional Engineer.

D. Submit a description and complete specification of the compaction equipment proposed for use

E. When using Recycled Concrete Aggregate or Non-Clean Fill, the Contractor shall submit a "Certificate of Clean Fill" as per 2.01 D.

END OF APPENDIX "A"

DIVISION 2

SECTION 02231

AGGREGATE BASE COURSE

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for dense graded aggregate base course (DGABC) and open graded aggregate base course (OGABC) each where shown on the Contract Drawings including the use of recycled concrete aggregate (RCA) as an alternate for virgin aggregate.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Material Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing
ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN m/m^3))
ASTM D 1883	Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2167	Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2434	Test Method for Permeability of Granular Soils (Constant Head)
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3665	Practice for Random Sampling of Construction Materials
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Aggregate Base Course shall not be placed or spread unless subgrade is free of frost and standing water.

2. Do not place aggregate base course, or perform any compaction operations when ground water level is above a plane two feet below the bottom of the base course. This condition would be indicated by existing water level readings, known site conditions or by the results of probes performed by the Contractor before material placement.

3. When necessary, lower and maintain ground water below the required plane by methods approved by the Engineer.

B. Design and Tolerance

1. The compacted base course, shall have a minimum California Bearing Ratio (CBR) of 80 as determined by ASTM D 1883. In the case of open graded aggregate base course the permeability, as tested in accordance with ASTM D 2434, shall be a minimum of 1.0×10^{-3} centimeters per second.

2. Surface of the base course shall be within plus or minus 1/2 inch of elevations shown on the Contract Drawings and free of depressions or projections greater than 3/8 inch when tested with a 16-foot straight edge applied parallel with or at right angles to the centerline.

3. Thickness of base course at any point shall not be deficient by more than 1/2 inch from the required thickness shown on the Contract Drawings.

4. The field density of the base course after compaction shall be at least 95 percent (100 percent for runways, taxiways and aprons) of the maximum density as determined by Procedure "C" of ASTM D 1557, with the exception that base course material passing the 1-1/2-inch sieve shall be used instead of the material passing the 3/4-inch sieve specified.

1.04 QUALITY CONTROL AND ASSURANCE

A. Provide and maintain quality control plans and procedures that shall ensure all base course materials and completed construction conform to this Section. The Engineer shall be afforded access to the Contractor's plant, equipment and field operations at all times for checking compliance with the approved quality control procedures. Provide labor and equipment to take samples as directed and assist the Engineer in other tests. Repair all areas from which samples are taken to meet all requirements of this Section.

B. The quality control plan shall include as a minimum:

1. Assignment of quality control responsibility to specifically-named individuals.

2. Outline of sampling location procedures and in-place density testing methodologies.

3. Performance of regularly scheduled inspections of the material source in the case of RCA.

4. Provisions for the prompt implementation of control and corrective measures.

5. Provisions for liaison with the Engineer at all times

6. Performance of necessary quality control tests, including use of a nuclear gauge.

C. For RCA, Quality Control procedures shall include performing the following tests on dedicated stockpiles being produced for use under this Contract:

1. Gradation tests (ASTM C 117, C 136, and D 422) shall be performed at least once per 4,000 cubic yards.

2. Moisture-Density tests (ASTM D1557) shall be performed at least once per 4,000 cubic yards.

3. Where using Recycled Concrete Aggregate (RCA):

a. Composition tests shall be a continuous visual inspection and shall include removal of any objectionable material to ensure compliance with 2.01B.

b. Soundness of Aggregates (ASTM C 88) and Resistance to Degradation (ASTM C 131) shall be performed a minimum of once every two weeks, unless otherwise directed by the Engineer.

D. For Contracts requiring over 500 cubic yards of aggregate base course, and where otherwise directed by the Engineer, select an area from the first day's production to be called a control strip. The control strip shall be a minimum of 2500 square feet and shall be constructed to meet the requirements of this section and in the same manner as the remainder of the course it represents. The purpose of the control strip is to have the contractor establish the compaction pattern, methods and effort required to achieve the quality requirements and to calibrate the Contractor's nuclear gage. Additional control strips shall be constructed whenever a significant change occurs in the type or source of the material and whenever a significant change occurs in the composition of the material from the same source.

E. Engineer's Sampling and Testing

1. The Engineer may elect to inspect, test, and approve aggregate base course at the source. At least five days prior to delivery of material to site, the Engineer shall be notified.

2. Base course material delivered to the construction site will be sampled and tested by the Engineer for conformance to the requirements specified in 2.01 A copy of the test analyses will be on file with the Engineer. The samples will be taken from stockpiles on site, prior to material placement operations. Minimum testing frequencies will be as follows:

	Aggregate Base Course
Gradation	1 test per 4,000 cubic yards
Moisture-Density	
Proctor Test	1 test per 4,000 cubic yards

3. The Engineer will check base course thickness at least once every 2500 sq. ft.

4. The Engineer will determine field density of compacted base course from in-place density tests. Frequency of testing will be at least one test every 2500 square feet per lift. Locations of random sampling shall be determined in accordance with ASTM D 3665. The in-place field density shall be determined in accordance with ASTM D 2922 and ASTM D 3017, or ASTM D 2167, or ASTM D 1556.

5. The Engineer will check conformance to elevations required by the Contract Drawings and required tolerance for surface straightness.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Virgin aggregate for base course shall be quarry processed, crushed dolomite, limestone, gneiss, or trap rock free from coatings of clay, silt, vegetable matter, and other objectionable materials, and shall contain no clay balls.

B. Recycled concrete aggregate for base course shall be as follows:

1. The RCA shall consist of at least 90 percent, by weight, Portland cement concrete, with the following materials making up the remaining 10 percent:

   Wood-0.1%, maximum
   Brick, Mica schist, or other friable material-4%, maximum
   Asphalt Concrete-10%, maximum

2. Virgin aggregate may be added to meet the 90% minimum concrete requirement.

3. The percentage of asphalt concrete and other deleterious material shall be determined by weighing that material retained on the No. 4 sieve, and dividing by the total weight of RCA material retained on the No. 4 sieve.

C. Gradation for aggregate base course shall be as follows:

1.

	Percentage Passing By Weight	
Sieve Size	DGABC	OGABC
1 1/2"	100	100
3/4"	55-90	60-95
3/8"		40-80
No.4	25-60	15-35
No. 50	5-25	8-20
No. 200	3-12	0-7

2. The portion passing the No. 40 sieve shall be non-plastic when tested in accordance with ASTM D 4318.

3. The aggregate base course shall have not less than 90% by weight with at least two fractured faces and 100% with at least one fractured face, and with a maximum of 7% of flat or elongated pieces. A flat piece is one having a ratio of length to width greater than five.

D. Soundness of Aggregates:

Loss limitation shall not be more than 10% loss by weight, using sodium sulfate for 5-cycle test period, or not more than 15% loss by weight, using magnesium sulfate for a 5-cycle test period as determined by ASTM C 88.

E. Resistance to Degradation:

Percentage loss between the original weight and the final weight of the test sample, shall not exceed 45% as determined by ASTM C 131.

F. Recycled Concrete Aggregate and Non-Clean Fill Stockpile Approval:

1. The Contractor shall submit to the Engineer a "Certificate of Clean Fill" for all imported fill material.

2. RCA proposed by the Contractor shall be from permitted or State registered Construction and Demolition Debris Processing Facilities (C&DDPF). The Contractor shall obtain and submit a copy of the permit or registration to the Engineer.

   a. In New York, the source of the RCA shall be C&DDPF conforming to 6 NYSRR Part 360-16: Construction and Demolition Debris Processing Facilities.

   b. In New Jersey, the source of the RCA shall be a Class B C&DDPF conforming to NJAC – Title 7: Environmental Protection; Chapter 26A: Recycling Rules.

3. For other imported fill material that does not have a "Certificate of Clean Fill", the Contractor shall submit a State Beneficial Use Determination or Reuse approval.

   a. In New York, the approval shall conform to 6 NYSRR Part 360-1.15: Beneficial Use.

   b. In New Jersey, the approval shall conform to NJAC 7:26-1.7: Exemption From Solid Waste Facility Permitting.

RCA will be sampled from lots as specified in 1.04 E.2. Each sublot of each lot shall meet all applicable test requirements of this Section. If any one sublot does not meet these requirements, the entire lot will be disapproved and shall not be used for the purposes of this Contract.

The Engineer will approve or disapprove the RCA within 4 days after sampling, unless the Engineer determines that soundness of aggregate or resistance to degradation tests specified in this Section 2.01 are required, in which case 21 days will be required for approval or disapproval. Do not deliver RCA until it has been approved by the Engineer.

After a lot has been approved, no additional material shall be added to the lot stockpile until that stockpile is exhausted. Any new stockpile formed shall be subject to testing and acceptance as described above.

PART 3. EXECUTION

3.01 INSTALLATION

A. Equipment

1. Placing and spreading equipment shall be approved by the Engineer and be capable of spreading material without segregation of aggregate sizes.

2. Steel vibratory rollers to be used for compaction, shall have provision for regulation of vibration frequency. Pneumatic rubber-tired rollers shall have a minimum weight of 20 tons and tire pressure of between 60 and 150 psi, as directed by the Engineer. All compaction equipment, including mechanical tampers when proposed, is subject to review an approval by Engineer.

B. Preparation of Subgrade

1. Verify that job conditions specified in 1.03 A have been met and there are no high points in the subgrade which would interfere with meeting the tolerance requirements specified in 1.03 B.

2. For granular subgrades, compact subgrade with a minimum of 6 passes of an approved vibratory steel roller, operating at the optimum operating frequency as recommended by the manufacturer.

3. For fine-grained soil subgrades, compact subgrade with a minimum of 6 passes of an approved pneumatic rubber-tired roller.

4. Rollers shall be operated at a speed not to exceed 3 miles per hour. Roller passes shall be overlapped a minimum of 6 inches.

5. All subgrade compaction operations shall be performed at or near optimum moisture content. In areas where use of a roller is impractical, compact subgrade with approved mechanical tampers.

6. Provide grade control as follows:

   a. Set grade stakes on a rectangular grid not more than 25 feet on centers.

   b. After firmly driving stakes, offset mark each 6 inches above the top of base course.

   c. Maintain stakes during placement and compaction of base course.

C. Placement and Compaction

1. Place base course materials evenly over the prepared subgrade with approved spreading equipment. In multi-layer construction, the previously constructed layer should be cleaned of loose of foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered by the next layer.

2. When spread, base course materials shall be at or near optimum moisture content and of a thickness such that the maximum depth of a compacted layer shall be 6 inches. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

3. Compact immediately after spreading, while at or near optimum moisture content, by rolling. The number, type and weight of rollers shall be sufficient to compact the material to the required density.

4. In areas where use of rollers is impractical, compact with manually operated equipment while at or near optimum moisture content.

5. The base course shall be maintained in a condition that will meet all specification requirements until the Work is accepted. Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

6. If, in the opinion of the Engineer, the compacted base course softened due to exposure to the elements, drain off all freestanding water and recompact the base course until density requirements are met.

D. Adjustment of Deficiencies

1. Scrape, add or remove material or replace deficient material, and recompact to meet specified density, grade or smoothness criteria.

2. In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be cut back to grade and rerolled.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

APPENDIX "A"

SUBMITTALS

A. Submit to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, all of the following:

1. The proposed source of material. Material must come from a source approved by either NYDOT or NJDOT. The Engineer will approve or disapprove within 10 working days after receipt of submittal. Do not deliver material until the Engineer has approved of the source.

2. In the case of RCA, the name of the intended supplier and certified test data demonstrating the supplier's compliance with the material requirements of 2.01, at least 21 days prior to delivery of any RCA to the construction site. The Engineer will approve or disapprove within 10 working days after receipt of submittal. Do not deliver material until the Engineer has approved of the source.

3. In the case of RCA, an actual material submittal from the proposed source may be required as the result of a new, unfamiliar or unsatisfactory supplier submittal. Two 75 pound representative samples from a dedicated stockpile proposed for use under this contract must then be supplied as follows:

   a. Submit RCA samples in clean, sturdy containers or bags that shall not permit loss of any of the material.

   b. Clearly label samples with the Contract location, title, and number; identification of the material supplied; and the location of the source.

   The Engineer will approve or disapprove within 21 days after receipt of sample. When an actual sample is required, do not deliver material to the site until Engineer has approved of the sample.

B. If the source and/or the supplier of the aggregate base course material changes, resubmittals for approval must be made in accordance with 1.05, above.

C. When using Recycled Concrete Aggregate or Non-Clean Fill, the Contractor shall submit a Certificate of Clean Fill as per 2.01 F.

END OF APPENDIX "A"

DIVISION 2

SECTION 02233

HYDRAULIC FILL FOR ABANDONED SEWERS AND WATER MAINS

PART 1. GENERAL

1.01 SUMMARY

A. This section describes the provision and placement of Hydraulic Fill For Abandoned Sewers and Water Mains.

1.02 SYSTEM DESCRIPTION

A. The Contractor shall hydraulically fill all sewers 12-inches and larger in their least dimension and all water mains 24-inches and larger in diameter that are to be abandoned within the limits of this contract as shown or specified with an excavatable flowable fill.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM International)

ASTM C150	Specification for Portland Cement
ASTM C618	Mineral admixtures

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. 28-Day Comp. Strength (psi) 50 – 100

1.05 DELIVERY, STORAGE, AND HANDLING

A. The hydraulic fill mix that has gone for a period of forty-five (45) minutes or longer from the time of mixing without being incorporated into the work shall be discarded. Remixing or tempering shall not be permitted.

1.06 QUALITY ASSURANCE

A. Hydraulic fill must be supplied from an established concrete plant that has been approved by the Engineer.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Hydraulic fill may be supplied from an established concrete plant that has been approved by the Engineer.

2.02 MATERIALS

A. Cement shall be Type-I or Type-II Portland Cement that conforms to the requirements of Specification 03300. Each bag of cement shall be deemed to be one (1) cubic foot.

B. Fine Aggregate - Sand shall be Concrete Sand or Natural Sand and shall conform to the requirements of Specification 03300.

C. Fly Ash shall conform to the chemical and physical requirements for Mineral Admixture, Class F listed in ASTM C618 including Table 1A (except for Footnote A). Loss on ignition shall not exceed four percent (4%).

D. Water shall be fresh, clean and free from oils, acids, alkali or organic matter.

E. Admixtures may be used in the Hydraulic Fill Mix to enhance certain properties. (Air entraining or water reducing admixtures shall not be used.) No admixtures may be used without the prior approval of the Engineer. Laboratory test results or Manufacturer's data must be submitted by the Contractor to the Engineer proving that the admixture will not detract from the specified twenty-eight (28) day compressive strength.

F. All admixtures considered for inclusion in the Hydraulic Fill Mix shall comply with the State of New York, Department of Transportation, Standard Specifications, Section 711-08 "Admixtures". The name of the admixture must be found on the "Approval List" issued by the NYS DOT Materials Bureau. The brand name of the approved admixture must be plainly marked on the admixture container.

2.03 MIX PROPORTION

A. HYDRAULIC FILL MIX PROPORTION PARAMETERS PER CUBIC YARD

The mix design proportion parameters per cubic yard shall be as follows:
Cement (lbs.) 30 - 70
Fly Ash (lbs.) 250 - 600
Fine Aggregate (lbs.) 2500 - 3000
Water (lbs.) (gal.) 350 (41.9) - 500 (59.9)
Slump (in.) 8 - 10
28-Day Comp. Strength (psi) 50 - 100

PART 3. EXECUTION

3.01 PREPARATION

A. The Contractor shall prepare a design mix and produce a trial batch to show compliance with the specifications and submit design mix and test results to the Engineer for approval prior to construction. The approved Hydraulic Fill Mix shall not be altered unless otherwise directed by the Engineer.

B. The hydraulic fill shall be thoroughly mixed, in a mechanical mixer, to the desired consistency and in accordance with ACI 506R-90 before being placed in a calibrated hopper for discharge into the abandoned sewer and/or water main through nozzles and or other suitable apparatus.

C. Calibration of the hopper shall be subject to inspection, verification and approval of the Engineer.

3.02 APPLICATION

A. The proposed method of application shall hydraulically fill the abandoned sewer and water main from bottom to top of existing sewer and water main and from bulkhead to bulkhead, complete, as directed by the Engineer.

B. The hydraulic fill mix shall not be placed during freezing weather at the site of application. The hydraulic fill mix shall not be placed when it is anticipated that the temperature during the following twenty-four (24) hours will drop below forty (40) degrees Fahrenheit at the site of application.

3.03 FIELD QUALITY CONTROL

A. Field test mix slump (in.) 8 – 10, mix temperature and weather temperature.

B. Inspect bulkheads.

END OF SECTION

SECTION 02233

HYDRAULIC FILL FOR ABANDONED SEWERS AND WATER MAINS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Installation Procedures: The proposed method of application shall be submitted to the Engineer for prior approval and shall be in a manner that will thoroughly hydraulically fill the abandoned sewer and water main from bottom to top of existing sewer and water main and from bulkhead to bulkhead, complete, as directed by the Engineer.

B. Included in this submittal shall be the recommended maximum distances for hydraulically filling the abandoned sewer and water main, together with drawings showing the locations of any sections of abandoned sewer and water main that require removal in order to facilitate the hydraulic filling operation.

C. Product design data, add mixtures, and mix proportions.

END OF APPENDIX "A"

DIVISION 2

SECTION 02251

APPROACH TEMPORARY SHORING SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This work shall consist of designing, furnishing, installing, maintaining and removing the complete shoring system(s) necessary to support the existing bridge during structure construction. The temporary shoring system is required to safely support the existing structure for staged removal of the existing structure, and construction of the proposed structure, without interrupting the traffic flow as shown in the Contract Drawings. This work shall take place over the entire duration of the staged construction.

B. The work under this section shall include, but is not limited to, furnishing, installing and removing:

1. Temporary supporting floorbeams/floorsystem to support the remaining existing superstructure and roadway deck for staged construction.
2. Temporary shoring towers, columns, cap beams, jacks, bearings, posts, stiffeners, bracing stringers, connections, anchor rods, anchor bolts, welds, cross beams, reinforced concrete seats and drilling and grouting as required.
3. Temporary concrete pads and/or foundations to support temporary shoring towers.
4. Excavation, compaction and backfilling with crushed stone and suitable material for foundation support of temporary shoring system.

C. Monitoring settlements of the temporary shoring system(s) shall be performed under Section 02495 – Vibration and Settlement Monitoring.

1.02 RELATED SECTIONS

A.	Section 02051	Approach Structure Demolition and Disposal
B.	Section 02221	Excavation, Backfilling and Filling
C.	Section 03200	Concrete Reinforcement
D.	Section 03301	Portland Cement Concrete, Long Form
E.	Section 05120	Structural Steel

1.03 REFERENCES

A. AASHTO LRFD Specifications for Highway Bridges, 6th Edition, 2012 as modified by current NYSDOT Blue Pages.

B. AASHTO Guide Design Specifications for Bridge Temporary Works, 1st Edition, 1995 modified by current interim revisions.

C. New York State Department of Transportation – Steel Construction Manual (SCM), 3rd Edition, dated March 2008, with current additions and modifications.

NOTE: In the various subsections of the "Steel Construction Manual" (SCM) or the NYSDOT Standard Specifications referenced in this specification, references to "The Department" shall be taken to mean the Port Authority of New York and New Jersey (Authority). "Deputy Chief Engineer Structures (DCES)" shall be taken to mean the Port Authority of New York and New Jersey Engineer (the Engineer).

D. New York State Department of Transportation Standard Specifications Construction and Materials (US Customary), dated May 1, 2008 with current additions and modifications.

E. AASHTO/AWS D1.5, 2008 Bridge Welding Code.

1.04 QUALIFICATIONS

A. Structural steel fabricators for all structural steel of the temporary shoring system shall be certified under the AISC Quality Certification Program, Category II, Simple Steel Bridge Structures.

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel materials for this work shall meet the requirements of NYSDOT Standard Specifications Section 564 – Structural Steel, and the following Materials subsections:

Structural Steel	715-01
High Strength Bolts, Nuts Washers	715-14

Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of NYSDOT Standard Specifications subsection 715-01 - Structural Steel.

B. The structural concrete and reinforcement used for this work shall comply with the requirements of Section 03301 and Section 03200.

C. Timber shall be free from any defects which might impair its strength or functional use. Timber used in the shoring system for blocking shall comply with the material requirements of NYSDOT Standard Specifications subsection 712-14 - Stress Graded Timber and Lumber

D. Backfill – See Section 02221 Excavation, Backfill and Filling, for backfill material requirements.

PART 3. EXECUTION

3.01 GENERAL

A. Temporary shoring system(s) includes, but is not limited to, all temporary support framing, temporary shoring, work platforms, temporary protective devices, temporary bracing/brackets and connections, temporary concrete pads and foundation materials, anchors, attachments, jacking and lifting operations, and incidentals, and systems removal, etc., as required for the staged construction and completion of the new structure.

B. The suggested temporary shoring design shown in the Contract Drawings is for illustrative purposes only. The load table for temporary shoring system as shown on the Contract Drawings is not to be used by the Contractor's Engineer for the design of the temporary shoring systems. The Contractor is required to submit for approval his own temporary shoring system, designed and stamped by an Engineer currently licensed to practice in the State of New York and New Jersey. The Contractor's shoring shall be consistent with the construction staging, and may or may not be similar to the suggested shoring system shown on the Contract Drawings. The temporary shoring system shall be designed to support all dead and live loads (including impact) of the staged construction and construction loads including wind, and accounting for seismic loads as applicable. The calculations and specifications completed by the Contractor's Engineer for the shoring system shall include stability analysis for all lateral and vertical loads during all stages of construction and shall be submitted to the Engineer for review and acceptance, prior to the start of such work.

The suggested temporary shoring design shown in the Contract Drawings includes being supported on the existing structure and foundations. The Contractor's Engineer shall prepare calculations and specifications for stability and capacity analyses of the existing structure under the temporary shoring loads and eccentricities and shall submit to the Engineer for review and acceptance, prior to the start of such work.

In addition, catalog cuts and product information for prefabricated system components and elements used in the Contractor's temporary support scheme shall be submitted to the Engineer as part of the Contractor's complete temporary support scheme design and construction package submittal.

C. The temporary shoring system shall be constructed consistent with the design developed by the Contractor and submitted to and accepted by the Engineer. The temporary shoring system shall resist any dislodgement due to bridge movement, vibration and loading. The Contractor shall be responsible for maintaining the temporary shoring system at all times, as well as, the existing structure carrying traffic during the construction; The Contractor shall also be responsible for stability of the existing/temporary structures throughout all stages of construction.

D. Settlement/movement of the existing structure supported by temporary shoring shall be monitored throughout the duration of the staged construction, in part, to verify that temporary shoring systems and existing structures are stable, and performing as designed. The frequency of monitoring shall be such that each location/temporary support is, at a minimum, surveyed daily. Depending on the type/configuration of temporary shoring system used, it may be preferable to install the settlement points directly on the sections of the exiting structure that are being temporarily supported (for example on the existing floorbeams and girders) in addition to and/or instead of on the temporary supports themselves. The rotation of the settlement points shall be such that rotation (tilting) in both the transverse and longitudinal directions as well as vertical settlement can be monitored.

E. The temporary shoring system shall be designed, constructed and maintained such that significant movements (displacements or rotations) do not occur. After the temporary supports are fully engaged, the total cumulative settlement values for each target/monument of the existing structure, including locations on the existing bridge superstructure directly above temporary supports (at the interface between the temporary support and the existing bridge superstructure) shall not exceed ½ inch and significant horizontal movement shall not occur. If the total cumulative settlement exceeds ½ inch or significant movements occur during demolition or construction, any work being performed on the structure shall be stopped and the Engineer shall be notified immediately. Work on the structure shall not proceed until a means to correct the movement and/or settlement of the structures is developed by the Contractor and approved by the Engineer.

F. The Contractor shall develop an inspection and monitoring plan, in conjunction with set of survey targets and a procedure to monitor them, which shall be submitted to the Engineer for review and approval prior to construction of the temporary shoring system. As work progresses, the Contractor shall monitor the survey targets at a frequency of not less than once per day and as ordered by the Engineer to detect any significant permanent vertical or horizontal movement. The records of monitoring, including record data, shall be submitted to the Engineer.

G. The temporary shoring system shall be removed when no longer required. The shoring system shall remain the property of the Contractor and shall be removed from the project site.

H. Lifting and Erection: The Contractor must obtain permit from the Authority for any operation during the erection or removal of the temporary shoring that requires any roadway or lane closure of the Bayonne Bridge.

3.02 WORKING DRAWINGS

A. Contractor shall submit working drawings, specifications and calculations for the proposed temporary shoring system, stamped and signed by an Engineer currently registered in the State of New York and the State of New Jersey for the Engineer's review and acceptance. The working drawings, specifications and calculations shall detail all work to be done under this item. Working drawings, specifications and calculations for this item shall be submitted 60 calendar days prior to start of temporary work.

In addition, catalog cuts and product information for prefabricated system components shall be included in the submittal package.

B. The temporary shoring design and work shall be in conformance with the latest references indicated in the Subsection 1.03 – REFERENCES, of this Section, including current additions and modifications.

C. The working drawings shall include:

1. All welds, connections and materials.
2. Erection procedures and details of installation of the system including a time schedule of operations. The working drawings shall show if the shoring is installed in stages.
3. All temporary foundations, towers, shoring stringers, bracings, support brackets and other details necessary for the erection and bracing of all shoring systems.

4. Loads (i.e. dead, live, impact, thermal, wind and seismic) for the corresponding construction stage(s).

D. When the working drawings, specifications and calculations are completed as specified, the Contractor shall submit five (5) sets of prints to the Engineer who will review and indicate thereon any correction deemed necessary by the Engineer. The Contractor may choose to submit electronically. Contractor shall coordinate with the Engineer to develop the protocol.

E. The Engineer shall be allowed four weeks after receipt of all pertinent information for the examination of the working drawings for this item

F. The Engineer's comments shall be indicated on the returned copies. Should the proposed system not be approved, the reasons shall be indicated with the return of the material. The Contractor shall then submit revised drawings for approval subject to the same terms as the first submission. Resubmission shall not be considered a legitimate reason to request an extension of time.

G. The Contractor shall carry out the construction in strict accordance with the approved working drawings and shall make no further changes therein except with the written approval of the Engineer.

H. Approval of the working drawings by the Engineer does not relieve the Contractor from assuming full responsibility for the method of construction for the temporary shoring system.

I. The Contractor shall distribute prints of the approved working drawings, specifications and calculations as follows:

five (5) sets of prints of working drawings and specifications to the Engineer

two (2) sets of calculations to the Engineer

J. The cost of all working drawing prints and reproducibles required by this specification shall be included in the lump sum price bid for this item. All prints and reproducibles requested beyond the number specified shall be furnished by the Contractor.

3.03 MATERIAL DAMAGED BY CONTRACTOR

A. The Contractor shall make every effort to maintain and to protect those elements of existing and new structures which intend to remain at the specified construction stage. Any damage to these structures by the Contractor's operations shall be repaired to the satisfaction of the Engineer, at the Contractor's expense, and no cost to the Authority.

3.04 INSPECTION BY ENGINEER

A. All work shall proceed in a workmanlike manner and shall be subject to the inspection of the Engineer or his/her representatives who shall be given all facilities required for a thorough inspection, at no cost to the Authority.

END OF SECTION

SECTION 02251

APPROACH TEMPORARY SHORING SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02251A01 Approach temporary shoring complete system design and working drawings, including details and specifications signed and sealed by a New York State P.E. and a New Jersey P.E..

Catalog Cuts

02251B01 Submittal of catalog cuts of "off the shelf" and prefabricated components, connections, etc. to be used in the temporary shoring system.

Product Data

02251D01 A complete "Products List", listing all the products/components to be used in the temporary shoring system. Include (where applicable): Product name, manufacturer, catalog cuts, details, samples (if requested by the Engineer), manufacturer's specifications and certified test data/analysis of each product.

Certificates

02251E01 Evidence confirming welder certification meeting NYSDOT requirements and/or New Jersey State DOT requirements, depending on the location on the bridge and the type of work being done.

Manufacturer Test Reports

02251F01 Certified copies of steel material test results from the manufacturer.

Calculations

02251H01 Approach temporary shoring complete system design calculations, including stability analysis of the temporary system, signed and sealed by a New York State P.E. and a New Jersey P.E..

02251H02 Approach temporary shoring complete system design calculations, including stability and capacity analysis of the existing structure, signed and sealed by a New York State P.E. and a New Jersey P.E..

Qualifications

02251K01 Qualifications showing that the temporary shoring support fabricator is certified in accordance with AISC, Category II, Simple Steel Bridge Structures.

Inspection Reports

02251O01 Contractor temporary support system and existing structure monitoring and inspection plan, including survey targets and records of daily readings, and records of inspection of the structural systems are being maintained and performing as designed.

Permits

02251T01 The Contractor must obtain permit from the Authority for any operation during the erection or removal of the temporary shoring system operations that requires roadway or lane closure of the Bayonne Bridge.

END OF APPENDIX "A"

DIVISION 2

SECTION 02260

SPECIAL EXCAVATION REQUIREMENTS

PART 1. GENERAL

1.01 SUMMARY

All special excavation and dewatering work, directed by the Engineer in accordance with the provisions of this Section

A. As determined by the Engineer, special excavation methods will be required when any of the following materials are found within the area of excavation: refuse, contaminated soil or water, or oil floating on top of the groundwater. "Refuse" shall mean any excavated material other than earth material. Work performed under these conditions will follow the Health and Safety Plan (HASP) submitted by the Contractor in accordance with 1.04. of this Section. Any dewatering undertaken in an area where the above condition is found shall be done in accordance with 3.02 of this Section.

B. All excavation shall be performed as specified in the Section entitled 02221 EXCAVATION, BACKFILLING AND FILLING, except for additional work associated with the removal of refuse, contaminated soil, or water with floating oil as described above.

C. Contractor shall secure all required United States Environmental Protection Agency (EPA), New Jersey Department of Environmental Protection (NJDEP), New York Department of Environmental Conservation (NYDEC), and United States Department of Transportation (USDOT) identification numbers, manifests, and placards for off-site transportation and disposal of removed equipment and materials under this Section and Sections 02050, 02110, 02112, 02892, 02894 and 02895 as applicable.

D. If required by the Engineer, the Contractor shall supply USDOT approved drums or containers for filling with materials, which shall include but are not limited to: residual product extracted from the excavation; product contaminated adsorbent materials used in cleaning equipment; product contaminated sorbent materials from on-site spill control procedures; rinse water from decontamination of equipment and materials; and personal protective equipment. Contractor shall place said filled drums or containers in the impoundment area as directed by the Engineer.

E. Contractor shall notify the Engineer immediately if soil which is visibly stained or has photoionization detector (PID) readings significantly above site specific background levels, is found within the excavation area.

F. Contractor shall notify the Engineer immediately if any of the materials described in 1.01 A. are detected within the excavation area.

G. The Contractor shall provide protective clothing and equipment for workers and enforce proper use of same, all in strict accordance with the applicable provisions of 29 CFR 1910 and 1926.

H. Contractor shall decontaminate in the decontamination area any equipment and materials that have come in contact with any of the materials specified in 1.01 A. herein.

I. Work by Others

If the conditions described in 1.01 A. are found, the following Work shall be performed by others:

Installation of soil borings and monitor wells, as well as testing of soil and water.

1. The preparation and submittal of any required Environmental Site Assessment and Closure Plans, the payment of associated filing fees, the submittal of the Site Assessment Compliance Statement and Checklist to the NJDEP.

2. Testing of all material for waste classification.

1.02 REFERENCES

For all work under this Section, the Contractor shall comply with the latest edition of all of the applicable industry codes, standards, and practices, including the following and shall supplement these references with any available, appropriate material.

American Petroleum Institute (API)

RP 2003	Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

New Jersey Department of Environmental Protection (NJDEP).

NJAC 7:26	New Jersey Solid and Hazardous Waste Regulations
NJAC 5:23	New Jersey Uniform Construction Code
NJSA 58:4A -	Subsurface and Percolating Waters Act

Underwriters Laboratories, Inc. (UL)

National Fire Protection Association (NFPA)

NFPA 10	Standard for Portable Fire Extinguishers
NFPA 30	Flammable and Combustible Liquids Code
NFPA 70	National Electric Code
NFPA 70B	Electrical Equipment Maintenance

United States Occupational Safety and Health Administration Agency (OSHA)

29 CFR Parts 1910 and 1926	Occupational Safety and Health Standards

United States Environmental Protection Agency (USEPA)

40 CFR Part 260 - 265 et. seq.	General Regulations for Hazardous Waste Management

1.03 JOB CONDITIONS

A. Contractor shall notify local and county health and fire officials prior to the performance of any Work of this Section, and shall obtain local Fire Department permits and/or licenses as required for all Work of this Section.

B. Contractor shall display or have available at all times at the construction site a copy of the Health and Safety Plan (HASP). The HASP shall be approved by a Certified Industrial Hygienist and signed by the Safety Officer as described in 1.04 herein.

C. "Safety Officer", as described in 1.04 herein, shall be present at all times during the Work of this Section.

D. Contractor shall provide sorbent pads, pillows, booms and blankets to impound product spills at all areas of product pumping, transfer and holding.

E. Contractor shall provide, operate, maintain and calibrate combustible gas indicators (CGI), portable photoionization detectors (PID), and percent oxygen indicators to assess gas / vapor concentrations in excavations in accordance with the HASP specified hereinafter. With regard to maintenance and use of this equipment:

1. Perform instrument cleaning, maintenance and calibration in accordance with manufacturer's instructions.

2. Use of personnel meeting the requirements of 1.04 A.2 herein to perform such testing is mandatory.

F. Use of flame cutting and operations that may create sparks are prohibited, unless permitted by the Engineer.

G. Equipment utilized for Work of this Section shall be capable of safe operation in NFPA 70 Class I, Division 1 locations, and equipment used for handling petroleum products shall be UL listed where such listings are available.

1.04 SUBMITTALS

A. Within 5 calendar days after receipt of the acceptance of his Proposal the Contractor shall submit:

1. The name and qualifications of the Industrial Hygienist responsible for reviewing and approving the Health and Safety Plan.

2. The name and qualifications of the Safety Officer proposed for use in performing the Work. The Safety Officer shall be responsible for the implementation and enforcement of the HASP. As a minimum, the Safety Officer must have the following qualifications:

a. Certification of completion of accredited courses in cardiopulmonary resuscitation (CPR) and First Aid, within the last 12 months.

b. Certification of completion of the OSHA (29 CFR 1910.120) or EPA Training Course 165.5, "Hazardous Materials Incident Response Operations" (40 hours, or 8 hour annual refresher course), within the last 12 months.

c. Certification of completion of the OSHA (29 CFR 1910.120) training course for Site Management and Supervision, within the last 12 months.

d. Documented experience as a Safety Officer on at least one project of similar size and scope.

B. Within 10 calendar days after receipt of the acceptance of his Proposal, the Contractor shall submit the site-specific Health and Safety Plan (HASP), prepared for use in performing the Work and bearing confirmation of review and approval by an Industrial Hygienist possessing valid certification by the American Board of Industrial Hygiene, which plan shall be in accordance with all applicable OSHA regulations. As a minimum, the HASP shall:

1. Identify key personnel responsible for site safety.
2. Address levels of personal protection to be employed during Work, setting forth specific criteria for choice of protective clothing and equipment.
3. Designate Work area exclusion zone and decontamination zone boundaries. Describe how zones will be marked/barricaded and made known to all persons at the construction site.
4. Establish site emergency procedures, for example, escape routes, signals for evacuating work parties, emergency communications, procedures for response to fire and explosions. Describe emergency equipment to be made available on site, such as portable extinguishers, first aid kit, etc.
5. Identify, provide location of, and list arrangements with the nearest medical facility.
6. Set forth a program for air monitoring in the Work area (exclusion zone). List and describe equipment to be used.
7. Set forth a program for monitoring for vapors and hazardous conditions in the excavations. List and describe equipment to be used.

C. Contractor shall submit the above for review in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS.

PART 2. PRODUCTS

None

PART 3. EXECUTION

3.01 GENERAL

A. All special excavation work shall be performed in conformance with the HASP.

B. Safety Officer shall test for presence of explosive and asphyxiating (i.e., confined space entry) conditions using portable CGIs, PIDs, and percent oxygen indicators in accordance with the HASP.

C. Deploy sorbent pads, pillows, booms and blankets as required to prevent surface water or product run-off from area of Work.

3.02 DEWATERING

A. The Contractor shall furnish and install a temporary groundwater recovery system at the locations where construction dewatering is required.

B. As determined by the Engineer, all water to be removed from the excavation area under the working conditions described in 1.01A. shall be collected in a tanker truck, transported and disposed of in the temporary storage tank described in Section 02145, or discharged in accordance with permits obtained by the Contractor from the applicable state, county and local authorities.

3.03 DECONTAMINATION OF EQUIPMENT AND MATERIALS

A. All decontamination procedures for equipment and materials shall conform to the requirements of applicable USEPA, NYDEC, and NJDEP regulations.

B. All recoverable equipment and materials, which have been in contact with contaminated excavated soil and refuse described in 1.01 A. shall be decontaminated prior to removal from the construction site. As used herein, "recoverable" shall mean all items which are non-absorptive in nature and which can successfully be decontaminated. As determined by the Engineer, all items for which decontamination is difficult or uncertain shall be considered non-recoverable.

C. Provide a non-porous barrier membrane of appropriate size and material under items being decontaminated to catch and hold rinse fluids and protect adjacent grade area. This barrier membrane and the rinse fluids shall be considered non-recoverable.

D. Decontaminate recoverable Contractor owned equipment and materials with pressurized steam. Do not utilize any detergent agents.

E. As directed by the Engineer, deposit non-liquid non-recoverable materials into USDOT approved containers described in 1.01 D. herein.

F. As directed by the Engineer, conduct rinse fluids into USDOT containers described in 1.01 D. herein.

G. Mark and placard drummed decontamination materials and place them in the impoundment area.

END OF SECTION

SECTION 02260

SPECIAL EXCAVATION REQUIREMENTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02260A01 Contractor shall submit the above for review in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 GENERAL PROVISIONS.

Construction and Installation Procedures

02260G01 1. Identify key personnel responsible for site safety.

02260G02 2. Address levels of personal protection to be employed during Work, setting forth specific criteria for choice of protective clothing and equipment.

02260G03 3. Designate Work area exclusion zone and decontamination zone boundaries. Describe how zones will be marked/barricaded and made known to all persons at the construction site.

02260G04 4. Establish site emergency procedures, for example, escape routes, signals for evacuating work parties, emergency communications, procedures for response to fire and explosions. Describe emergency equipment to be made available on site, such as portable extinguishers, first aid kit, etc.

02260G05 5. Identify, provide location of, and list arrangements with the nearest medical facility.

02260G06 6. Set forth a program for air monitoring in the Work area (exclusion zone). List and describe equipment to be used.

02260G07 7. Set forth a program for monitoring for vapors and hazardous conditions in the excavations. List and describe equipment to be used.

Schedules

02260J01 Within 5 calendar days after receipt of the acceptance of his Proposal the Contractor shall submit:

02260J02 Within 10 calendar days after receipt of the acceptance of his Proposal, the Contractor shall submit the site specific Health and Safety Plan (HASP), prepared for use in performing the Work and bearing confirmation of review and approval by an Industrial Hygienist possessing valid certification by the American Board of Industrial Hygiene, which plan shall be in accordance with all applicable OSHA regulations. As a minimum, the HASP shall:

Qualifications

02260K01 1. The name and qualifications of the Industrial Hygienist responsible for reviewing and approving the Health and Safety Plan.

02260K02 2. The name and qualifications of the Safety Officer proposed for use in performing the Work. The Safety Officer shall be responsible for the implementation and enforcement of the HASP. As a minimum, the Safety Officer must have the following qualifications: a. Certification of completion of accredited courses in cardiopulmonary resuscitation (CPR) and First Aid, within the last 12 months; b. Certification of completion of the OSHA (29 CFR 1910.120) or EPA Training Course 165.5, "Hazardous Materials Incident Response Operations" (40 hours, or 8 hour annual refresher course), within the last 12 months; c. Certification of completion of the OSHA (29 CFR 1910.120) training course for Site Management and Supervision, within the last 12 months; d. Documented experience as a Safety Officer on at least one project of similar size and scope.

END OF APPENDIX "A"

DIVISION 2

SECTION 02272

SOIL EROSION AND SEDIMENT CONTROL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the construction and maintenance of various, temporary soil erosion and sediment control measures, including relocation as required for staged construction.

1.02 REFERENCES

American Society for Testing and Materials (ASTM) ASTM C 33 Specification for Concrete Aggregates

1.03 REQUIREMENTS

A. Environmental Requirements

1. Apply dust retardants other than water only when wind velocity is less than 5 mph and drift hazard is negligible.
2. Conform to "Seeding Calendar Limitations" of the Section entitled "SEEDING".
3. Use Dust Retardant or other approved methods for temporary surface stabilization of short duration where establishing grass by seeding is not practical.

B. Construction Requirements

1. The Contractor shall employ soil erosion and sedimentation control measures during the duration of the contract to control erosion and minimize the sedimentation of water courses on the construction site.
2. The Contract Drawings do not include borrow pits or storage areas that the Contractor utilizes or establishes outside of the site in order to perform the Work. If the land disturbance for this Work is five thousand square feet (5,000 SF) or greater, the Contractor shall provide the Engineer with documentation that a soil erosion and sediment control plan has been approved for this Work by the appropriate Soil Conservation District of the New Jersey Department of Environmental Protection.
3. The Contractor shall incorporate all permanent pollution control features into the project at the earliest practicable time. Temporary soil erosion and sediment control measures shall be coordinated with the permanent pollution control features and with the construction of pavement, drainage facilities such as pipes, culverts, headwalls, channels, ditches, etc., to the maximum extent practical to assure economical, effective and continuous erosion control throughout the duration of the Contract, as outlined in the approved progress schedule.

4. Prior to all grubbing operations, soil erosion and sediment control measures shall be installed. When unstabilized areas caused by site development, grading, or other earth disturbing activities exist beyond 14 calendar days, the areas disturbed shall be seeded and mulched. These requirements pertain to perimeter controls, berms, dams, swales, ditches and slopes. Upon completion of the grading or construction, disturbed areas shall be permanently stabilized in accordance with the Contract Drawings within 7 calendar days.

5. When excavation or embankment construction reaches the finished subgrade, those areas on which paving is to be placed are exempt from the above stabilization requirements. Roadways and haul roads actively being used for daily conveyance of equipment as well as areas between temporary berms, except median areas, are also exempt unless otherwise shown on the Contract Drawings.

6. Streams shall be protected from soil erosion and sediment. Streams being diverted shall be protected through the use of silt fences. Temporary diversion channels shall be lined with geotextile and temporary riprap.

7. The turbid discharge from dewatering construction activities shall be contained in a dewatering basin in order to control sediment and provide filtration of water prior to it being released into adjacent streams or other watercourses.

8. Soil being stockpiled shall be placed in well-drained areas no closer than 50 feet from streams, wetlands, floodplains and other watercourses, unless otherwise directed by the Engineer. The stockpiles shall be seeded and mulched in accordance with the Contract Drawings. Temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles.

9. Temporary soil erosion and sediment control measures shall be used to correct conditions that develop during construction.

10. In the event that temporary soil erosion and sediment control measures are required due to the Contractor's failure, for any reason, to install or maintain soil erosion and sediment controls, either as part of the work or as directed by the Engineer, such Work shall be performed by the Contractor at no additional cost to the Authority.

11. If the Contractor is not in compliance with soil erosion and sediment control provisions, corrective actions shall be taken immediately. The Engineer may suspend the Work, wholly or in part, until such time as the Contractor is fully in compliance. All corrective and remedial work required to bring the Contractor into compliance shall be performed at no additional cost to the Authority.

12. Temporary soil erosion and sediment control measures shall be removed when necessary to allow for the installation of permanent control features or as permanent controls become functional. Before issuance of a Certificate of Final Completion, all items used for temporary soil erosion and sediment control shall be removed unless otherwise shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

A. Progress Schedule

1. The Contractor shall prepare a progress schedule for the Engineer's approval in accordance with Division 1 of the Specifications.

2. The progress schedule shall clearly outline the intended maintenance of traffic, the locations where temporary and permanent soil erosion and sediment control measures shall be installed, and such other information as required. The progress schedule shall give special consideration to sensitive areas such as wetlands, waterways, etc. Appropriate staging and seasonal constraints shall be used to maximize the effectiveness of the soil erosion and sediment controls. The progress schedule shall also indicate when Work is restricted in these sensitive areas as outlined in permits issued by regulatory agencies.

B. Soil Erosion and Sediment Control Manager

1. The Contractor shall assign to the project a supervisory-level employee to serve in the capacity of Soil Erosion and Sediment Control Manager. This employee shall be thoroughly experienced in all aspects of soil erosion and sediment control and construction. The Contractor shall submit the name and experience of this employee to the Engineer for approval at least 10 working days prior to commencing any Work on the project. Replacement of the Soil Erosion and Sediment Control Manager during the Contract shall be made only after approval of a written request for such replacement.

2. The Soil Erosion and Sediment Control Manager shall implement approved soil erosion and sediment control schedules and methods of operations. He shall coordinate his operations with the Engineer and shall oversee and supervise all aspects of soil erosion and sediment control work for the project.

He will attend all soil erosion and sediment control meetings during the Contract.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

1.06 DELIVERY, HANDLING AND STORAGE

Protect materials against damage prior to installation.

1.07 SPARE MATERIALS

During construction, the Contractor shall have on hand sufficient spare materials and appurtenances as are necessary to repair damage to permanent and temporary installations.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geotextiles shall conform to the Section entitled "Geotextiles". Unless otherwise shown on the Contract Drawings, geotextiles shall have a maximum Apparent Opening Size of 0.6 mm. and minimum permeability of 1×10^{-3} cm/sec.

1. Silt Fences and Inlet Filter Sediment Control shall be "Self Supported".

2. Geotextiles for other Soil Erosion and Sedimentation Control items shall be "Erosion Control - Class A".

B. Wood stakes, posts and boards shall be solid, reasonably knot-free lumber conforming to the nominal size specified on the Contract Drawings.

C. Hay bales shall consist of timothy , red top or native grasses securely bound with wire or baling twine. The twine shall be an ultra-violet light stabilized polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds.

D. Rip rap shall be broken stone (argillite, calcite, dolomite, gneiss, granite, quartzite, traprock). Unless otherwise shown on the Contract Drawings, riprap shall have a designated median stone (D50) size in the range of 6 to 9 inches maximum dimension, weighing not more than 150 pounds, with at least 90% weighing more than 25 pounds but not more than 40% exceeding 100 pounds, having the following characteristics:

Characteristic	Max. %
Weathered decomposed stone	5
Other than that classification approved	5
Absorption in cold water	1.8
Sodium sulfate soundness, loss by weight	10

E. Coarse aggregate shall be broken stone or washed crushed gravel meeting the specification for rip rap except for size and weight requirements. Size and gradation shall be as shown on the Contract Drawings.

F. Welded wire fabric shall conform to AASHTO M55 flat sheets or rolls.

G. Pipe for temporary slope drains shall be minimum 8-inch diameter of type shown on the Contract Drawings.

H. Seed and mulch shall be as specified in the Section entitled "SEEDING".

I. Topsoil Stabilization Matting.

Topsoil stabilization matting shall be one of the following:

1. Excelsior mat shall be wood excelsior, 48 ± 1 inch in width and weighing 0.8 pounds per square yard, ± 5 percent. The excelsior material shall be covered with a netting to facilitate handling and to increase strength and shall be biodegradable.

2. Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 ± 1 inch width and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of ± 5 percent, with approximately seventy-eight warp ends per width of cloth and forty-one weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one half its normal diameter.

J. Dust Retardant

1. "Coherex" as manufactured by Golden Bear Division of the Witco Corporation, Chandler, AZ 85244.

2. "Soil-Sement" as manufactured by Midwest Industrial Supply, Inc., Canton, OH 44711.

3. "Soil Seal Concentrate" as manufactured by Soil Seal Corporation, Los Angeles, CA 90017.

4. Or approved equal.

K. Calcium Chloride shall be Grade 2, in the form of loose dry granules or flakes, and shall be fine enough to feed through commonly used spreaders at the specified rates.

2.02 CONSTRUCTION FEATURES

A. Silt Fence

1. Silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2-foot high fence after 1 foot of fabric is buried in the existing soil. Heavy-duty silt fence shall consist of geotextile whose width shall be at least 4 feet to provide for a 3 foot high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. Fence posts shall be installed at a slight angle toward the anticipated runoff source.

2. Heavy-duty silt fence shall include a welded wire mesh backing for the geotextile. This welded steel wire mesh shall be galvanized and contain 4 inch square openings. The geotextile shall be secured to the welded wire mesh.

B. Haybale Check Dams with Temporary Stone Outlets

1. Haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. The temporary stone outlets, consisting of riprap stones conforming to the requirements for temporary riprap, shall be placed in the center of each flow line. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each stone outlet.

2. The riprap stones and coarse aggregate shall be placed on geotextile, and shall be embedded into the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

C. Temporary Stone Check Dams

1. Temporary stone check dams shall be constructed in ditches to reduce flow velocity.

2. The check dams shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each check dam.

3. The riprap stones and coarse aggregate shall be placed on geotextile and shall be embedded in the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

D. Temporary Slope Drains

1. Temporary slope drains shall be installed on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope.

2. The drain pipe shall be staked to the slope or secured with riprap stones to prevent movement or displacement. A flared end section shall be attached at each end of the pipe and elbows shall be installed as required to conform with the existing changes in slopes.

3. A temporary earth berm and haybales shall be constructed at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. The haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale.

4. Riprap stones, conforming to the requirements for temporary riprap, shall be placed loosely at both ends of the pipe to prevent scour. The riprap stones shall be placed on geotextile which, at the top of slope, shall be draped over the earth berm. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

E. Inlet Filters

1. For existing inlet structures, geotextile shall be placed under the grates, over the curb pieces and extend a minimum of 6 inches beyond. Coarse aggregate, size No. 8, shall be placed behind each curb piece and on the geotextile to secure the in place.

2. Openings required in new inlet walls to provide for temporary drainage shall be covered with welded wire mesh, geotextile and coarse aggregate, size No. 8.

3. Inlet filters, consisting of welded steel wire mesh and geotextile shall be installed to control sedimentation at new inlet drainage structures. Inlet filters of geotextile alone shall be installed to control sedimentation at existing inlet drainage structures.

4. For new inlet structures, welded steel wire mesh shall be molded around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Geotextile shall then be secured to the welded wire mesh. Coarse aggregate, size No. 8, shall be placed against the inlet structures to hold the inlet filter in place.

5. Inlet filters shall be removed before scheduled paving operations begin.

F. Inlet Protection (Haybale Barrier)

1. Inlet protection (haybale barrier) shall consist of haybales that completely encircle inlet drainage structures. The perimeter length of the haybale barrier shall be at least four times the perimeter length of the inlet structure. Haybales shall not encroach into the traveled way.

2. Haybales placed around inlet structures within earthen areas shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. Haybales placed around inlet structures within pavement areas shall be placed on top of the pavement, tied together to prevent movement and shall not be anchored in place.

G. Inlet Sediment Traps

1. Inlet sediment traps, consisting of silt fence and temporary stone inlets, shall be constructed to control sedimentation at existing and proposed inlet drainage structures.

2. The silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2-foot high fence after 1 foot of geotextile is buried in the existing soil. Sections of geotextile shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. The silt fence shall be installed around the drainage structure and into the stone inlets. Fence posts shall be installed at a slight angle toward the anticipated flow.

3. The temporary stone inlets, consisting of coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed in each flow line upgrade of the inlet structure. The coarse aggregate shall be placed on geotextile that shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

H. Floating Turbidity Barriers

1. Floating turbidity barriers, consisting of 10-mil. thick polyethylene plastic sheets suspended from floats, shall be installed in streams or other watercourses to intercept silt coming from drainage pipes or that caused by construction operations within waterways.

2. Barriers shall be located 50 feet from the point of discharge of drainage pipes or from the area of construction operations affecting waterways. The barriers shall extend across the entire waterway or radially from the shoreline.

I. Temporary Stone Outlet Sediment Traps

1. Temporary, stone outlet sediment traps, consisting of temporary basins and riprap spillways, shall be constructed within existing, proposed and temporary ditches.

2. The spillways shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of the spillways.

3. The riprap stones and coarse aggregate shall be placed on geotextile that shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

J. Dewatering Basin

1. Dewatering basins shall be constructed within the Site and outside any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure in order to control sediment and provide filtration of water.

2. The dewatering basins shall be sized by the Contractor to entirely contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of water present within the area to be dewatered. The material to be used to form the basin is at the discretion of the Contractor. The outfall of the basin shall be such that the water exiting the basin does not cause erosion to, or scouring of, the area onto which the water is being discharged.

PART 3. EXECUTION

3.01 PREPARATION

A. Clearing and grubbing operations shall be so scheduled and performed that grading, mulching, seeding and other permanent pollution control features can follow immediately thereafter according to the approved progress schedule. Should seasonal limitations make such coordination unattainable, additional temporary soil erosion and sediment control measures shall be performed between successive construction stages, as directed.

B. The amount of surface area of erodable earth material exposed at one time by clearing and grubbing, excavation, borrow or fill operations, without stabilization, shall not exceed 750,000 square feet for clearing and grubbing operations, or 750,000 square feet for grading operations without prior approval. The Engineer may increase or decrease these amounts commensurate with the Contractor's ability to keep the construction on the approved progress schedule.

C. Obtain the Engineer's approval before starting any operations that would require seeding for stabilization when seeding is restricted by the calendar limitations of the Section entitled "SEEDING". Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method shall be approved by the Engineer before implementation and may include use of the Dust Retardant or other methods.

3.02 INSTALLATION

A. Embankment Areas

1. Side ditches shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earth work. Stabilization for the ditches and swales shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.

2. Embankment greater than 25 feet in height shall be stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be either temporarily seeded and mulched, or permanently stabilized, before proceeding with the next stage. At the completion of the final stage of embankment placement, the entire slope, if not previously done, shall be permanently stabilized.

3. At the end of each workday, temporary stabilized earth berms and slope drains shall be constructed along the top edges of the embankment to intercept surface runoff.

B. Excavation Areas

1. Ditches to be used in a cut section, and side and outlet ditches, shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earthwork. Stabilization for the ditches shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.

2. Slopes greater than 25 feet in height shall be excavated and stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be permanently stabilized before proceeding with the next stage, in accordance with the time limitations specified herein.

C. Dust Control

1. Employ construction methods and means that keep flying dust to a minimum. Provide for the laying of water or other dust control materials on the project and on roads, streets and other areas immediately adjacent to the project limits, and wherever traffic or buildings that are occupied or in use are affected by such dust caused by his hauling or other construction operations. The materials and methods used for dust control shall be as specified herein or as directed by the Engineer.

2. Apply Dust Retardant in accordance with the manufacturer's written instructions. Reapply as often as required. Calcium chloride shall not be used in any areas to be seeded or landscaped.

3. Calcium chloride may only be used on pavement subgrades subject to the approval of the Engineer. Care shall be exercised when using calcium chloride on steep slopes to prevent the calcium chloride from washing into streams or accumulating around plants or in landscape areas. Calcium chloride shall not be applied in solution. Apply calcium chloride at a rate of approximately 1.5 pounds per square yard.

D. Dirt Control

1. The Contractor shall provide for prompt removal from existing roadways of all dirt and other materials that have been spilled, washed, tracked or otherwise deposited thereon by his hauling and other operations, whenever the accumulation is sufficient to cause the formation of mud, interfere with drainage, damage pavements or create a traffic hazard.

2. In order to minimize tracking of dirt and other materials onto existing roadways, a stabilized construction driveway shall be constructed at locations where vehicles exit a work site. The construction driveway shall consist of a layer of broken stone, which shall be a minimum 4 inches thick and 100 feet long where practical, and of sufficient width to serve the intended purpose. The broken stone shall be 2 1/2 - inch nominal size conforming to ASTM C-33 size No. 2. The driveway shall be maintained by top dressing with additional stone, as directed, and shall be removed when no longer required.

E. Seeding

Temporary and permanent seeding shall be in accordance with the Section entitled "SEEDING".

3.03 SOIL EROSION AND SEDIMENT CONTROL MAINTENANCE

A. Soil erosion and sediment control measures shall be maintained during the Contract even when the Work is suspended. Controls shall be inspected immediately after each rain, and any required corrective work shall immediately be performed. Riprap stones, coarse aggregate, silt fence, or haybales damaged due to washouts or siltation shall be replaced.

B. Sediment traps and basins shall be cleaned out when they are 50 percent filled. Silt fences, stone outlet structures, dams, and haybales shall have sediment removed when the sediment reaches 50 percent of the height of the soil erosion and sediment control measure. Sediment removed shall be disposed of in accordance with the Contract Drawings.

END OF SECTION

SECTION 02272

SOIL EROSION AND SEDIMENT CONTROL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

02272B01 Submit catalog cuts for the following:
a. Geotextiles
b. Pipe for Slope Drains
c. Topsoil Stabilization Matting
d. Dust Retardant

Certificates

02272E01 Submit certificate from geotextile manufacturers that geotextiles comply with the requirements specified in this Section.

02272E02 Submit documentation of approval of soil erosion and sediment control plan for offsite land disturbance greater than 5000 square feet.

Manufacturer Test Reports

02272F01 Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data the following:
a. Riprap
b. Coarse Aggregates

Construction and Installation Procedures

02272G01 Submit a Progress Schedule reflecting the requirements of Section 1.04 A.

02272G02 Submit alternate methods for stabilizing disturbed areas when seeding calendar limitations apply.

Calculations

02272H01 Submit design computations for sizing of Dewatering Basins prepared by a Professional Engineer, licensed in the State in which the Work will be performed

Qualifications

02272K01 Submit name and applicable experience of Soil Erosion and Sediment Control Manager in accordance with Section 1.04 B.

END OF APPENDIX "A"

DIVISION 2

SECTION 02273

GEOSYNTHETIC CLAY LINER OVER TEXTURED HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the furnishing and installation of a geosynthetic clay liner (GCL) over a textured (double-sided) HDPE geomembrane on the bottom and sloping sides of the detention basins located within the New Jersey state limits.

1.02 REFERENCES

Standards from the American Society for Testing and Materials (ASTM) and Geosynthetic Research Institute (GRI) are referenced in this Section. The following is a list of the publications referenced:

ASTM D1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting

ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

ASTM D1505 Test Method for Density of Plastics by the Density-Gradient Technique

ASTM D1603 Test Method for Carbon Black in Olefin Plastics

ASTM D3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

ASTM D4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds

ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

ASTM D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

ASTM D5084 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

ASTM D5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic of Geosynthetic and Geosynthetic Friction by the Direct Shear Method

ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

ASTM D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber

ASTM D5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

ASTM D5887 Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter

ASTM D5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners

ASTM D5891 Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners

ASTM D5993 Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners

ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes

ASTM D6243 Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method

ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

ASTM D6496 Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners

ASTM D6768 Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

ASTM D7240 Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)

ASTM D7466 Standard Test Method for Measuring the Asperity Height of Textured Geomembrane

ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

GRI GM 14 Standard Guide for Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

1.03 QUALITY ASSURANCE

A. Construction Standards: Construction of GCL and HDPE geomembrane shall be in accordance with the respective manufacturers' recommendations subject to approval of the Engineer. Storage and handling of rolls of GCL and rolls of HDPE geomembrane shall be done in accordance with the provisions of ASTM D4873.

B. The entity performing the Work of this section shall be a contractor experienced in GCL and HDPE geomembrane installation with suitable equipment and competent personnel. The Contractor shall submit a list of at least three GCL projects and at least five HDPE geomembrane projects successfully completed in the past five years. The Contractor shall submit descriptions of the GCL projects and HDPE geomembrane projects completed in the last five years to serve as evidence of the capability to install GCL and HDPE geomembrane. The descriptions of the GCL projects and HDPE geomembrane projects shall contain names and telephone numbers of owners' representatives who can verify the Contractor's participation on those projects. These descriptions shall be submitted with the product specifications and will be evaluated by the Engineer. The Contractor shall also submit qualifications of key staff responsible for overseeing GCL installation and HDPE geomembrane installation.

C. The Contractor shall provide at least one Master Seamer for the HDPE geomembrane installation. The Master Seamer shall have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

D. Quality assurance (QA) testing of the GCL shall be performed at testing frequencies listed below but no less than once per each basin location at which the GCL is used. The Contractor shall be responsible for collecting and testing the samples in an independent laboratory approved by the Authority and accredited by the Geosynthetics Accreditation Institute. Sampling and testing shall be as specified by the Engineer. The testing shall include the following:

1. Mass per unit area (ASTM D5993) (One test per 20,000 square feet)
2. Hydraulic conductivity (ASTM D5084 or ASTM E96) (one test per 100,000 square feet)
3. Direct shear testing (ASTM D6243), (one test per 100,000 square feet)
4. Peel testing (ASTM D4632) (one test per 20,000 square feet)

E. QA testing of the HDPE geomembrane shall be performed at the testing frequencies listed below but no less than once per each basin location at which the HDPE geomembrane is used. The Contractor shall be responsible for collecting and testing the samples in an independent laboratory approved by the Authority and accredited by the Geosynthetics Accreditation Institute. Sampling and testing shall be as specified by the Engineer. The testing shall include the following:

1. Thickness (ASTM D5994)
2. Tensile Properties (ASTM D6693) (one per 1000,000 square feet)
3. Tear Resistance (ASTM D1004) (one test per 20,000 square feet)
4. Puncture Resistance (ASTM D4833) (one test per 20,000 square feet)
5. Asperity Height (ASTM D7466) (one per 20,000 square feet)

F. Required values for QA testing shall be as specified herein in Subsections 2.01.A and 2.01.B.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions:

1. The Contractor shall notify the Engineer with a minimum seven-day notice before proceeding with the Work.
2. The Contractor shall protect all adjacent structures and utilities from damage due to the Work. Prior to the start of installation activities, the Contractor shall locate and pre-excavate to expose portions of the existing utilities within the GCL and HDPE geomembrane installation area, and provide support and protection as necessary such as not to adversely affect the integrity of the utilities due to construction activities. The excavation and support methods shall be approved by the Engineer.
3. Should uncharted or incorrectly charted structures or utilities be encountered, the Engineer shall be immediately notified and consulted for directions as to procedure. The Contractor shall coordinate with the Authority, and public and private utility companies in keeping their respective services and facilities in operation. Damaged structures and utilities shall be repaired to the satisfaction of the Engineer, structure owner, or utility owner at no expense to the Authority.

1.05 SUBMITTALS

A. See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geosynthetic Clay Liner

1. Geosynthetic clay liner (GCL) shall be Bentomat DN as manufactured by CETCO or approved equal.
2. GCL shall consist of a layer of sodium bentonite between two geotextiles which are needle punched together
3. The GCL manufacturer shall have a Manufacturing Quality Control (MQC) plan which describes the procedures for accomplishing the final product quality, various tests to be conducted and their frequency. This MQC document shall be fully implemented and followed. As a minimum the plan shall satisfy the following requirements:

Material Property	Test Method	Test Frequency	Required Values
Bentonite Swell Index	ASTM D5890	1 per 50 tons	24 mL/2g minimum
Bentonite Fluid Loss	ASTM D5891	1 per 50 tons	18 mL maximum
Bentonite Mass/Area	ASTM D5993	40,000 ft^2	0.75 lb/ft^2 minimum
GCL Tensile Strength*	ASTM D6768	200,000 ft^2	45 lbs/in minimum, (machine direction)
GCL Peel Strength*	ASTM D4632	40,000 ft^2	3.5 lbs/in minimum, (machine direction)
GCL Index Flux	ASTM D5887 or ASTM E96	Weekly	$1x10^{-8}$ $m^3/m^2/sec$ maximum
GCL Hydraulic Conductivity	ASTM D5084 or ASTM E96	Weekly	$5x10^{-9}$ cm/sec maximum
GCL Hydrated Internal Shear Strength	ASTM D5321	Periodic	500 psf minimum @ 200 psf

*Grab and peel strength test results shall be minimum average roll values

4. The product shall be wrapped around a structurally sound core which can support the weight of the roll without excessive bending or buckling under normal handling conditions.

5. All rolls shall be labeled and covered with a waterproof, tightly-fitting, plastic covering that is resistant to photodegradation by ultraviolet (UV) light. The covering shall be placed around the GCL in a manner so as to effectively protect the product on all of its exposed surfaces and edges.

B. High-Density Polyethylene (HDPE) Geomembrane

1. High-Density Polyethylene (HDPE) geomembrane shall be GSE HD Textured (on both sides) Geomembrane as manufactured by GSE Lining Technology, LLC or approved equal, with a minimum thickness of 60 mils.
2. HDPE geomembrane shall consist of a flexible, coextruded textured high-density polyethylene (HDPE) geomembrane liner and shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
3. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane. Natural resin without carbon black shall meet the following requirements:

Resin Property	Test Method	Required Values
Density	ASTM D1505	0.932 g/cm^3 minimum
Melt Flow Index	ASTM D1238*	1.0 g / 10 minutes maximum
OIT	ASTM D3895^	100 minutes minimum

* 190 grams tested for 2.16 minutes
^ Tested at 1 atmosphere and 200°C

4. HDPE geomembrane shall not contain more than a combined maximum total of 1 percent by weight of additives other than carbon black.
5. The HDPE geomembrane manufacturer shall have a Manufacturing Quality Control (MQC) plan which describes the procedures for accomplishing the final product quality, various tests to be conducted and their frequency. This MQC document shall be fully implemented and followed. . As a minimum, the plan shall satisfy the following requirements:

Material Property	Test Method	Test Frequency	Minimum Average Values
Thickness	ASTM D5994	1 per roll	60 mils^
Density	ASTM D1505	200,000 lbs	0.94 g / cm^3
Tensile Properties*			
Strength at Break			90 lb/inch-width
Strength at Yield	ASTM D6693	20,000 lbs	126 lb/inch-width
Elongation at Break			100%
Elongation at Yield			12%
Tear Resistance	ASTM D1004	45,000 lbs	42 lbs
Puncture Resistance	ASTM D4833	45,000 lbs	90 lbs
Carbon Black Content	ASTM D1603 or ASTM D4218	20,000 lbs	2.0% to 3.0%

Carbon Black Dispersion	ASTM D5596	45,000 lbs	See Note (1)
Asperity Height	ASTM D7466	second roll at each basin	18 mils
Notch Constant Tensile Load**	ASTM D5397	200,000 lbs	300 hrs
Oxidative Induction Time^^	ASTM D3895	200,000 lbs	> 100 minutes

Note (1): Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2 with no more than 1 view from Category 3.
^ Lowest individual reading shall not be lower than 54 mils.
*Testing shall demonstrate compliance in each direction with Type IV Dumbbell at 2 inches/minute.
**Testing to be conducted on representative smooth geomembrane samples.
^^Testing to be performed at 200°C using O_2 at 1 atmosphere.

6. The HDPE geomembrane shall be supplied in roll form, with each roll labeled to indicate roll number, thickness, length, width, and manufacturer.
7. All rolls shall be covered with a waterproof, tightly-fitting, plastic covering that is resistant to photodegradation by ultraviolet (UV) light. The covering shall be placed around the HDPE geomembrane in a manner so as to effectively protect the product on all of its exposed surfaces and edges.
8. Prior to installation of the HDPE geomembrane, the Contractor shall provide product data to the Engineer for approval consisting of resin data, including certification stating that the resin meets the specification requirements, and a statement certifying that no recycled polymer is added to the resin.
9. Extrudate material, for the extrudate rod or bead, shall be made from the same type of resin as the geomembrane, and shall be free of contamination by moisture or foreign matter with additives thoroughly dispersed.

PART 3. EXECUTION

3.01 GENERAL

1. It shall be Contractor's responsibility to install the GCL and HDPE geomembrane, including subgrade preparation, dewatering, GCL placement, GCL joining, HDPE geomembrane placement, HDPE geomembrane seaming, sealing around pipes and structures, and backfilling.
2. Installation of GCL and HDPE geomembrane shall be in accordance with the respective manufacturers' recommendations, except as specified herein.
3. All labor, materials, equipment, and tools as required to prepare the site and install the GCL and HDPE geomembrane shall be supplied by the Contractor.
4. The Contractor shall provide for the services of on-site manufacturers' technical representatives to assist and instruct for the duration of the installation of the GCL and HDPE geomembrane at the first constructed basin.

3.02 INSTALLATION

A. Storage & Shipment

1. Geosynthetic Clay Liner

a. At the manufacturing facility, the GCL shall be stored indoors until it is ready to be transported to the detention basin site. Handling of the GCL shall be such that the protective wrapping is not damaged. If it is, it must be immediately rewrapped. In the case of minor tears, it may be taped. Placement and stacking of rolls shall be done in a manner so as to prevent thinning of the product at the points of contact with the storage frame or with one another.

b. The GCL shall be shipped by itself with no other cargo which could damage it in transit, during stops, or while off-loading other materials. Prior to shipment, the GCL manufacturer shall label each roll, identifying

(1) Product identification information, including manufacturer's name and address, brand product code

(2) Lot number and roll number

(3) Roll length, width, and weight

c. The method of loading GCL rolls, transporting, and off-loading at the job site shall not cause any damage to the GCL, its core, or its protective wrapping. Any protective wrapping damaged or stripped off of the rolls shall be repaired immediately or the roll moved to an enclosed facility until repair can be made to the approval of the Engineer.

d. If any bentonite has been lost during transportation or from damage of any type, the outer layers of the GCL shall be discarded until undamaged product is evidenced. The remaining roll must be rewrapped in accordance with the manufacturer's original method to prevent hydration or further damage to the remaining roll.

e. Storage at the site shall be in an enclosed facility. Alternatively, storage at the job site will be acceptable if the GCLs are properly positioned, protected, and maintained. The following precautions shall be followed:

(1) Handling of the rolls of GCL shall be done in a manner such that damage does not occur to the product or its protective wrapping. In this regard, the provisions of ASTM D4873 shall be followed.

(2) The location of temporary field storage shall not be in an area where water can accumulate.

(3) The rolls shall be stored on high flat ground or elevated off the ground so as not to form a dam creating ponding of water.

(4) The rolls shall not be stacked so high as to cause thinning of the product at points of contact. Manufacturer's recommendations shall be followed in this regard.

2. HDPE Geomembrane

a. Rolls of HDPE geomembrane shall be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

b. HDPE geomembrane shall be stored on-site at a level, smooth, and dry location adjacent to the area to be lined in order to protect the geomembrane from punctures, abrasions, and excessive dirt and moisture. In general, the location shall be level, smooth, dry, protected.

c. Handling of HDPE geomembrane shall be done in a manner to prevent damage to the material.

d. All sheets of HDPE geomembrane shall be inspected by the manufacturer prior to shipment for compliance with the material property requirements specified in Subsection 2.01.B and shall be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified, and indicated during manufacturing, these pinholes may be corrected during installation.

B. Subgrade Preparation

1. The subgrade soil shall conform to the following requirements before installation of the HDPE geomembrane:

   a. Preparation of the subgrade and installation of the HDPE geomembrane, GCL and full height of overlying cover soil shall be under dry conditions and all measures shall be taken to provide such condition, including sheeting or other methods, if necessary, to restrict groundwater flow into the excavation. Disposal of water during dewatering shall be in accordance with Subsection 02145 and all other applicable specifications sections.

   b. The particle size distribution of the subgrade soil shall be such that at least 80 percent of the soil is finer than 0.25 millimeters. If the subgrade material does not satisfy this requirement, a 1-inch (25-millimeter) thickness of 0.25 millimeter sand shall be used to provide the needed padding for the HDPE geomembrane.

   c. The subgrade soil shall be compacted such that the surface satisfies a 90 percent modified proctor density.

   d. The finished surface shall be clear of vegetation, construction debris, rocks and stones, voids, cracks, ice, or standing water.

2. Immediately prior to installation of the HDPE geomembrane, the subgrade shall be smooth-rolled to provide the best contact with the HDPE geomembrane. After this operation is completed, no wheel ruts, footprints, or other irregularities shall exist in the subgrade.

3. All protrusions extending more than 0.5 inches (12 millimeters) from the surface shall be removed, crushed, or pushed into the subgrade with a smooth-drum compactor.

4. Any necessary localized variation in elevation of the GCL or HDPE geomembrane at the bottom of the detention basin at structures or outlets shall be accommodated by a slope not exceeding 1V:4H.

5. The anchor trench shall be excavated in accordance with the project plans. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist within the trench.

C. GCL PLACEMENT

1. Prior to installation, the Contractor shall provide to the Engineer for approval installation layout drawings, showing proposed panel layout including overlaps and details, and the Contractor's geosynthetic field installation quality assurance plan. Approval of these layout drawings and quality assurance plan shall be obtained prior to the start of basin excavation.

2. Packaging of the GCL shall be removed after delivery to the working area and immediately prior to placement.

3. The Engineer's approval of the subgrade surface conditions must be obtained before installation of the GCL.

4. The GCL shall be placed flat on the installed geomembrane without wrinkles or folds. On side slopes, the GCL shall be anchored at the top and then unrolled so as to keep the material free of wrinkles and folds.
5. Care must be taken to minimize dragging of the GCL in order to avoid damaging the geomembrane. A temporary geosynthetic rub sheet shall be used, if necessary, to reduce friction damage during placement, in accordance with the manufacturer recommendation.
6. On side slopes, the GCL shall be placed such that the seams are parallel to the direction of the slope. No seams in the horizontal direction will be allowed.
7. Any placed GCL shall not be left uncovered overnight. The GCL shall be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin.
8. No GCL will be accepted if hydrated under less than a 12-inch thickness of cover soil.
9. Sealing around pipes and structures shall follow the manufacturer's recommendations. Details of the sealing technique shall be provided to and approved by the Engineer.
10. Conformance testing shall be performed on at least three GCL samples for each basin taken from the rolls delivered to the site as specified in Section 1.03.4.

D. GCL Joining

1. Joining of GCL is accomplished by overlapping without sewing or other mechanical connections. Joining of GCL panels shall be performed according to the manufacturer's recommendation.
2. The overlap distance shall not be less than 12 inches for longitudinal seams. For end of roll seams, the minimum overlap shall be not less than 24 inches. The overlap zone shall be free of loose soil or other debris. A continuous bead of granular sodium bentonite shall be applied along the overlap zone after exposing the underlying panel and spreading the bentonite over the overlap area.
3. The bentonite at the seams shall be applied at a rate according to the manufacturer's recommendations but not less than 0.4 pounds per linear foot (0.6 kg per linear meter) for each foot of overlap distance.

E. GCL Repairs

1. A GCL torn or punctured during installation may be repaired by providing a patch over the damaged area. The patch shall be obtained from a new GCL roll and cut in such a way that a minimum overlap of 12 inches is provided around all boundaries of the damaged area.
2. Dry bentonite or bentonite mastic shall be applied around the damaged area prior to placement of the patch according to the manufacturer's recommendation. An adhesive, approved by the manufacturer, shall be used to affix the patch in place so that it does not get displaced during placement of the cover soil.

F. HDPE Geomembrane placement

1. Prior to installation, the Contractor shall provide to the Engineer for approval installation layout drawings, showing proposed panel layout including field seams and details, and the Contractor's geosynthetic field installation quality assurance plan. Approval of these layout drawings and quality assurance plan shall be obtained prior to the start of basin excavation.

2. The Contractor shall assign each panel a simple and logical identifying code.
3. Visually inspect the HDPE geomembrane during unloading and throughout installation for imperfections and mark faulty or suspect areas.
4. Sufficient material, i.e. slack, shall be provided to allow for thermal expansion and contraction of the material.
5. Installation of HDPE geomembrane shall be performed in a manner complying with the following guidelines:
   a. Unroll the geomembrane using methods that will not damage the geomembrane and will protect the underlying surface from damage.
   b. Place ballast, e.g. sandbags, on the geomembrane to prevent wind uplift without damaging the HDPE geomembrane.
   c. Personnel walking on the geomembrane shall not engage in activities or wear shoes that could damage the geomembrane.
   d. Smoking shall not be permitted on the geomembrane.
   e. Heavy vehicular traffic directly on the geomembrane shall not be permitted. Protect the geomembrane with a protective cover in areas of heavy traffic. Rubber-tired all terrain vehicles (ATV's) and trucks are acceptable in wheel contact is less than 8 psi.

G. HDPE GEomembrane Seaming

1. Orient seams parallel to the line of slope, i.e. down and not across the slope, to the maximum extent possible.
2. Minimize the number of field seams in corners, odd-shaped geometric locations, and outside corners.
3. Slope seams, i.e. panels, shall extend a minimum of 5 feet beyond the grade break into the flat area.
4. A sequential seam numbering system compatible with the panel numbering system shall be used.
5. Align seam overlaps consistent with the requirements of the welding equipment being used but no less than a 6-inch overlap.
6. Welding equipment and accessories used for seaming the HDPE geomembrane shall have gauges present showing temperatures in the apparatus, such as extrusion welder or fusion welder. An adequate number of welding equipment shall be available to avoid delaying the work. The Contractor shall provide a power source capable of providing constant voltage under combined line load.
7. During welding operations, at least one Master Seamer shall be on-site to provide direct supervision over other welders as necessary.
8. For extrusion welding, the Contractor shall follow the following requirements:
   a. Hot-air tack adjacent pieces together using procedures that do not damage the HDPE geomembrane.
   b. Clean geomembrane surfaces by disc grinder or equivalent method.
   c. Purge welding apparatus of heat-degraded extrudate before welding.
9. For Hot Wedge Welding, the Contractor shall follow the following requirements:
   a. The welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.

b. Clean seam area of dust, mud, moisture, and debris, immediately ahead of hot wedge welder.

c. Protect against moisture build-up between sheets.

10. Trial Welds

a. Prior to the start of each day's production seaming operations, the Contractor shall perform trial welds on geomembrane samples to verify that welding equipment is operating properly.

b. Trial welds shall be made under the same surface and environmental conditions as the production welds, i.e. in contact with subgrade and similar ambient temperature.

c. A minimum of two trial welds shall be performed per day, per welding apparatus: one prior to the start of work and one at mid-shift.

d. Cut four, one-inch wide by six-inch long test strips from the trial weld.

e. Quantitatively test the test strip specimens for peel adhesion and then for shear strength.

f. Trial weld specimens shall pass when testing achieves the results shown in the following table:

HDPE Weld Property	Test Method	Minimum Weld Value
Peel Strength (extrusion)	ASTM D6392	78 ppi
Peel Strength (fusion)	ASTM D6392	98 ppi
Shear Strength	ASTM D6392	121 ppi

(1) During peel testing of the trial weld specimen, the break is ductile and occurs in the liner material itself and not through the peel separation.

g. When any of the trial weld samples fail in either peel or shear, the Contractor shall repeat the trial weld in its entirety at no cost to the Authority.

h. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed the trial weld.

11. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation per manufacturer's guidelines. The Contractor shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

H. HDPE Geomembrane Seam Field Testing

1. Field testing of the HDPE geomembrane seams shall be performed by non-destructive and destructive testing methods except when explicitly stated otherwise in these specifications.

2. Non-Destructive testing may be performed as the seaming progresses or upon completion of all field seaming with the goal of validating 100% of the seams. Non-Destructive testing shall be performed by the following methods:

a. Vacuum testing shall be performed in accordance with ASTM D5641.

b. Air pressure testing shall be performed in accordance with ASTM D5820.

c. Spark testing shall be performed in accordance with ASTM D7240.

d. Other non-destructive methods approved by the Engineer.

3. Destructive testing shall be performed at locations to be determined by the Engineer after seaming. Samples for destructive testing shall be collected at a frequency of one per every 500 linear feet of seam length. Destructive testing shall exercise the Method of Attributes described in GRI GM-14 to minimize the test samples taken. Sampling for destructive testing shall be performed as follows:
   a. The Contractor shall cut samples at locations designated by the Engineer as the seaming progresses to obtain field laboratory test results before the geomembrane is covered.
   b. The Engineer will number each sample, and the location will be noted on the as-built installation plan.
   c. Samples shall be 12 inches wide and of minimal length, with the seam centered lengthwise.
   d. Cut a 2-inch wide strip from each end of the sample for field testing.
   e. Cut the remaining sample into two parts: one 12-inch by 12-inch piece for the Contractor and one 12-inch by 8-inch portion for a third party laboratory. Additional samples may be collected if required by the Engineer.
   f. Destructive testing shall be performed in accordance with ASTM D6392. Testing shall be performed by a laboratory accredited by the Geosynthetic Institute.
   g. The Contractor shall repair all holes in the HDPE geomembrane resulting from destructive sampling and shall test the continuity of the repair in accordance with these Specifications.
4. In the event the seam fails, the Contractor shall adhere to the following procedure:
   a. Reconstruct the seam between any two passed test locations, or trace the weld to an intermediate location at least 10 feet or where the seam ends in both directions from the location of the failed test.
   b. The next seam welded using the same welding device shall obtain an additional sample if one side of the seam is less than 10 feet long.
   c. If the sample passes, then the seam shall be reconstructed or capped between the test sample locations.
   d. If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

I. HDPE Geomembrane Repairs
1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
2. The Contractor shall repair any portion of unsatisfactory HDPE geomembrane or seam area failing a destructive or non-destructive test at no cost to the Authority.
3. The Contractor shall repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover the HDPE geomembrane at locations that have been repaired until test results with passing values are available.
4. The Contractor shall remove damaged HDPE geomembrane and replace the damaged geomembrane with acceptable HDPE geomembrane materials if damage cannot be satisfactorily repaired.
5. The repair method shall be agreed to by the Contractor and Engineer and shall be one of the below methods:

a. Patching shall be used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.

b. Abrading and re-welding shall be used to repair short sections of a seam.

c. Spot welding shall be used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

d. Capping shall be used to repair long lengths of failed seams.

e. Flap welding shall be used to extrusion weld the excess outer portion (i.e. flap) of a fusion weld in lieu of a full cap.

f. Removal of the unacceptable seam and replacement with new material may also be an appropriate repair method.

6. At the time of HDPE geomembrane repair, all geomembrane surfaces shall be clean and dry. Surfaces of HDPE which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.

7. Patches or caps shall extend at least 6 inches for extrusion welds and at least 4 inches for wedge welds beyond the edge of the defect and around all corners of the patch material.

8. Each repair section shall be numbered and logged and shall be non-destructively tested using methods specified in Subsection 3.02.H.2 to verify the acceptability of the repair.

J. Backfilling or covering

1. Soil cover shall be placed over the GCL in a manner that will minimize stress on the GCL. A minimum of 14 inches of cover soil shall be maintained between equipment tires/tracks and the GCL. A temporary minimum thickness of 24 inches shall be maintained for frequently trafficked areas, and the excess thickness removed when no longer required.

2. During soil placement, care shall be taken to ensure that soil does not penetrate the GCL overlap zones.

3. In those areas where riprap protection is required no riprap material or stone shall be placed directly on the GCL. A minimum 6-inch thickness of cover soil shall underlie any riprap or stone material in order to prevent damaging the GCL.

4. Cover soil material and vegetation shall be in accordance with Section 02670 Bioretention System.

END OF SECTION

SECTION 02273

GEOSYNTHETIC CLAY LINER OVER TEXTURED HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

APPENDIX "A"

SUBMITTALS

Submit the following, in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS

A. Qualifications of both the entity or entities performing the work and the technical specialist(s) supervising the work in accordance with Section 1.03.2

B. Manufacturing Quality Control plan for GCL

C. Manufacturing Quality Control plan for HDPE Geomembrane

D. Two copies of the GCL manufacturer's installation manual

E. Two copies of the HDPE geomembrane manufacturer's installation manual

F. Contractor's geosynthetic field installation quality assurance plan

G. HDPE geomembrane installation layout drawings meeting requirements of Sections 3.02.c and 3.02.D

H. GCL installation layout drawings

I. Details of geomembrane seaming and sealing around pipes and structures

J. Details of GCL seaming, sealing around pipes and structures, and backfilling

K. Product data of HDPE geomembrane

L. Product data of GCL

END OF APPENDIX "A"

DIVISION 2

SECTION 02274

GEOTEXTILES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for geotextiles (fabrics) made of polymers for the following applications:

1. Subsurface Drainage
2. Sediment Control
3. Erosion Control
4. Separation of Dissimilar Materials (including subgrade stabilization)

B. This Section does not specify requirements for geotextiles for the following application:

1. Reinforcement within pavement structures and paving membranes
2. Reinforcement for embankment structures
3. Polymeric liners (geomembranes)

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M288 Standard Specification for Geotextiles

American Society of Testing and Materials (ASTM)

ASTM D 4354 Standard Practice of Sampling of Geosynthetics for Testing

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Unless otherwise shown on the Contract Drawings or Specified herein, the geotextiles shall conform to the applicable requirements of AASHTO M288.

1.04 QUALITY ASSURANCE

A. Geotextile materials will be visually inspected by the Engineer when delivered to the construction site. Damaged materials or materials not meeting the requirements of this Section shall be removed from the construction site and replaced.

B. Engineer's Sampling and Testing

1. The Contractor shall furnish labor, equipment and materials to take samples, and to repair all areas where samples are taken.
2. Quality Assurance (QA) testing of the physical requirements of the geotextile fabric will be performed by the Engineer using random samples obtained from materials delivered to the job site.
3. The Engineer will perform field seam tests on random samples obtained in the field.
4. Unless otherwise shown on the Contract Drawings, the Engineer will determine the lot sizes for testing based on ASTM D 4354 and the type and number (minimum three) of tests per lot.

1.05 DELIVERY, HANDLING AND STORAGE

Comply with AASHTO M288 to protect materials against moisture and ultraviolet exposure prior to installation.

1.06 SPARE MATERIALS

During construction, the Contractor shall have on hand sufficient spare geotextile materials and appurtenances as necessary to repair damage to permanent and temporary geotextile installations.

1.07 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. General

Fibers used for the manufacture of geotextiles and the threads used in joining geotextiles by sewing shall comply with the physical and chemical requirements of AASHTO M288.

B. Geotextile

For the indicated application, comply with the physical requirements of AASHTO M288 Table 1 Physical Requirements and with Permeability and Apparent Opening Size as noted on the Contract Drawings.

1. Subsurface Drainage: "Class A"
2. Sediment Control: "Self Supported"
3. Erosion Control: "Class A"
4. Separation of Dissimilar Materials (including subgrade stabilization): "High Survivablility Level"

C. Temporary Silt Fences

1. Geotextiles for temporary silt fences shall meet the requirements for sediment control, self supported, of AASHTO M288 Table 1 unless otherwise shown on the Contract Drawings.

2. Posts and appurtenances shall be in accordance with the fabric manufacturer's written recommendations, except as otherwise shown on the Contract Drawings.

3. Prefabricated silt fences with the geotextiles affixed to the posts are permitted.

PART 3. EXECUTION

3.01 PREPARATION

A. Prepare surfaces against which the geotextile will be installed by clearing and grading as required to remove surface irregularities or projections which may interfere with the installation or which may damage the geotextile.

B. Plan the work such that the exposure of the geotextile between laydown and coverage shall be limited to a maximum of fourteen (14) days.

3.02 INSTALLATION

A. General

1. Install the geotextile as shown on the Contract Drawings and as specified herein.

2. Unroll and place the geotextile to maintain a smooth surface and in such a manner that placement of overlying materials will not excessively stretch or tear the geotextile.

3. Factory or field sewn or sealed seams shall meet the applicable requirements of AASHTO M288 Table 1.

4. Unless otherwise shown on the Contract Drawings or specified herein, overlapped seams shall have a minimum overlap of 12 inches except when placed underwater where the overlap shall be a minimum of three (3) feet.

5. Remove or repair damaged geotextile as directed by the Engineer. Repairs shall be made with a geotextile patch placed over the damaged area and extending three (3) feet beyond the perimeter of the damage, and shall be seamed to match the surrounding installation.

B. Subsurface Drainage Installations

1. At seams, overlap the fabric in the direction of flow with upstream over downstream.

2. Where seams are required in the longitudinal trench direction and within the trench, they shall be sewn or have a minimum overlap equal to the trench width.

C. Erosion Control Installations

1. Terminal ends of the geotextile shall be anchored at the crest and toe of slopes as shown on the Contract Drawings.

2. For slope protection installations, successive sheets shall be overlapped with upstream over downstream and/or upslope over downslope.

3. Placement of armor stone, rip-rap and aggregate bedding onto the geotextile shall begin at the toe and proceed upslope. For underwater applications, the first layer of such material shall be placed the same day as the geotextile is installed.

4. The height from which material shall be dropped onto the geotextile shall be limited to one (1) foot unless otherwise shown on the Contract Drawings.

D. Separation and Subgrade Stabilization Installations

1. Unroll the material in the direction of construction traffic unless otherwise directed by the Engineer. Adjacent rolls shall be overlapped in the direction of material placement and as shown on the Contract Drawings.

2. Anchor the geotextile as required using pins, staples or piles of the material to be placed on the fabric.

3. Form curves cut from pieces lapped in the direction of construction or by folding in the direction of construction.

4. Placement of material onto the geotextile shall be as specified on the Contract Drawings.

E. Sediment Control Installation

1. Install and maintain sediment controls, as shown on the Contract Drawings.

2. Removal and disposal of temporary sediment controls, and restoration of the site shall be as shown on the Contract Drawings.

PART 4. FIELD TESTS AND ADJUSTMENTS

A. Proofroll and correct deficiencies as required by the Contract Drawings or as specified in other Sections of the Specifications.

B. Unless otherwise shown on the Contract Drawings, correction of deficiencies and additional proof rolling shall be at no additional cost to the Authority.

C. Testing of field seams shall be by the Engineer as specified elsewhere herein.

END OF SECTION

SECTION 02274

GEOTEXTILES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

02274C01 When required on the Contract Drawings, submit manufacturer's representative samples of the fabric to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397. The type, quantity and purpose of such samples shall be as shown on the Contract Drawings.

Certificates

02274E01 Submit manufacturer's certificates of compliance with all requirements for materials specified in this Section.

Quality Assurance-Quality Control

02274L01 Submit fabric manufacturer's Quality Control (QC) plan for the production process. The plan shall specify the specific testing proposed to verify the physical and chemical properties required by this specification and the frequency of tests, including suggested lot sizes and number of tests per lot.

END OF APPENDIX "A"

DIVISION 2

SECTION 02376

MICRO-PILES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for small diameter, cast-in-place, drilled micro-piles.

B. Furnish all labor, materials, tools and equipment, and perform all operations necessary to install grout-filled micro-piles drilled into bedrock at the locations shown on the Contract Drawings and as specified herein. The work consists of drilling through existing reinforced concrete footings where required, underlying overburden including boulders and into rock, furnishing and installing steel casing into rock, furnishing and installing steel reinforcement within the casing, filling with grout and cutting off pile tops to design elevation.

1.02 SYSTEM DESCRIPTION

A. Job Conditions

1. Furnish and install the piles in accordance with these Specifications, Contract Drawings and the referenced codes and regulations.
2. Protect existing structures, including the existing bridge structures, adjacent residential, commercial and other structures, maintenance facilities and utilities to the satisfaction of the Engineer and the facility and utility owners.
3. Instrumentation and monitoring and implementation of required Response Action Plans during micro-pile installation shall be performed as per Specification Section 02212, titled "GEOTECHNICAL INSTRUMENTATION AND MONITORING" and the Contract Drawings.
4. All excavated materials shall be disposed of away from the construction site. Procedures for handling, transport, reuse, temporary stockpiling and testing, if required, and disposal of the excavated materials and drilling fluids shall be as shown on the Contract Drawings and described in pertinent environmental Contract Specification sections. Disposal of slurry, drilling water, and excess grout in storm drains is not permitted.

B. Site Conditions

1. The Contractor shall be aware that the subsurface conditions may include boulders, cobbles, concrete debris, existing bridge foundations, steel reinforcement bars, brick, wood, concrete, fractured rock, and other obstructions that must be penetrated during installation of the piles. No claim for additional costs will be allowed for micro-pile installation through the obstructions

2. Inspect the site prior to the start of work to evaluate the conditions affecting the work. Review all details of the work and working conditions, verify dimensions in the field including variable headroom clearances, workspace and interference from adjacent or existing structures, and advise the Engineer of any discrepancy before performing any work. All conditions affecting work must be evaluated. No claim for additional costs will be allowed because of lack of knowledge of any existing conditions discernible from observation at the site, adjacent foundations and structures, adjoining property, boring logs, and other available sources of information.
3. Consult the Contract Drawings and the official records of existing utilities, both surface and subsurface, and excavate test pits at work locations to observe existing conditions and limitations as they apply to this work and their relation to other construction work.
4. Protect existing utilities that are to remain within the pile installation work zone, in accordance with the requirements of authorities having jurisdiction over the same. Repair any construction-induced damage to the utilities or replace the damaged utilities in kind, in a timely manner to the satisfaction of the utility owners, at no additional cost to the Authority.
5. Bridge traffic on the existing Bayonne Bridge and access to site shall be maintained at all times without interruption, except as approved by Engineer.

1.03 REFEERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO	LRFD Bridge Design Specifications

American Society for Testing and Materials (ASTM International)

ASTM-	*Standard Specification for:*
ASTM A108	Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A252	Welded and Seamless Steel Pipe Piles
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A709	Structural Steel for Bridges
ASTM C33	Concrete Aggregates
ASTM C150	Portland Cement
ASTM C494	Chemical Admixtures for Concrete
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM	*Standard Test Method for:*
ASTM C109	Compressive Strength of Hydraulic Cement Mortars(Using 2-in. or [50-mm] Cube Specimens)

ASTM C311	Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM D1143	Testing of Piles Under Axial Compressive Load
ASTM D1586	Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM	*Standard Practice for:*
ASTM D2133	Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
	American Concrete Institute (ACI)
ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI SP-66(04)	ACI Detailing Manual-2004
ACI 318	Building Code Requirements for Structural Concrete and Commentary
	American Welding Society (AWS)
AWS D 1.1	Structural Welding Code - Steel
AWS D 1.4	Structural Welding Code - Reinforced Steel
AWS D 1.5	Bridge Welding Code
	American Petroleum Institute (API)
API 5CT(N80)	Specification for Casing and Tubing, with a minimum yield strength of 80 ksi
	Federal Highway Administration (FHWA)
FHWA SA-91-042	Static Testing of Deep Foundations
	International Society for Rock Mechanics (ISRM)
ISRM	Suggested Methods For The Quantitative Description of Discontinuities In Rock Masses

1.04 RELATED SECTIONS

A. Section 02110 – Excavation, Staging, Handling, Transportation, and Disposal of Hazardous Materials for the West First Street Site in Bayonne, New Jersey

B. Section 02112 – Excavation, Staging, Handling, Transportation, and Disposal of Non-Hazardous Materials for the West First Street Site in Bayonne, New Jersey

C. Section 02212 – Geotechnical Instrumentation and Monitoring

D. Section 02145 – Dewatering

E. Section 02221 – Excavation, Backfilling and Filling

F. Section 02260 – Special Excavation Requirements

G. Section 02892 – Handling, Treatment and Disposal of Soil Materials (New Jersey)

H. Section 02894 – Handling, Treatment And Disposal of Non-Hazardous Soil Materials (New York)

I. Section 02895 –Disposal of Hazardous Material

J. Section 02897 – Contaminated Materials Management

K. Section 03200 – Concrete Reinforcement

L. Section 03301 – Portland Cement Concrete, Long Form

1.05 DESIGN AND PERFORMANCE REQUIREMENTS

A. The location, minimum pile and rock socket diameter, required design capacity, estimated top of rock elevation, minimum rock socket length, and pile cutoff elevation are shown on the Contract Drawings. The Contractor is responsible for determining the actual rock socket length(s) required to produce piles which will comply with the acceptance criteria shown on the Contract Drawings. Submit design calculations for determining the lengths of rock sockets for the micro-piles, in conformance with the minimum requirements shown on the Contract Documents. Rock socket lengths shall not be less than the minimum socket lengths shown on the Contract Drawings. No alternative pile types will be accepted.

B. See Contract Drawings for additional requirements for micro-pile load tests.

C. Provide an installation method that minimizes ground loss and resultant settlement of nearby structures.

D. Utilize the same materials and dimensions for the piles as used for the piles which have been proven by load tests.

E. Installation Alignment and Tolerances

1. The pile casing alignment shall not deviate by more than two percent from plumb.
2. Piles at cut-off level shall not deviate by more than two inches horizontally from the specified locations shown on the Contract Drawings.
3. Cut off the top of the pile within one inch of the elevation shown on the Contract Drawings or as directed by the Engineer.
4. Centerline of reinforcing steel bar shall not be more than 3/4-inch from centerline of pile.

1.06 QUALITY ASSURANCE

A. The Contractor or approved Subcontractor performing this work shall be a firm regularly engaged in the installation of grout-filled, drilled micro-piles. The Contractor or approved Subcontractor shall have experience successfully completing at least five projects of similar size and complexity using this type of pile within the last five years. The experience shall include installing such piles drilled through obstructions and bedrock, using non-displacement rotary duplex drilling techniques or equivalent non-displacement methods.

B. Assign an experienced, full-time supervisor who has been in responsible charge of supervising the installation of grout-filled drilled micro-pile operations for at least five similar projects in the prior five years. The supervisor shall be present at the Work site at all times during the pile installation. Submit written verification of the supervisor's experience for review and approval of the Engineer.

C. Installation of production piles shall not begin until authorized in writing by the Engineer.

D. Do not begin production pile installation work prior to receiving written approval of pile load tests and calculated production pile rock socket lengths from the Engineer. Ordering material prior to the approval is discouraged and is solely at the risk of the Contractor. Review and approval of pile load tests by the Engineer does not constitute a guarantee that the production pile installation will be accepted by the Authority. The Contractor shall be fully responsible for satisfactorily completing the work as detailed on the Contract Drawings and in these Specifications.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Materials used for the cement grout shall be stored in accordance with ACI 304R.

B. Deliver reinforcing bars marked with metal tags indicating size, length, grade and mark numbers.

1.08 SUBMITTALS

A. See Appendix A for Submittal Requirements

B. Work shall not begin until the appropriate submittals have been received and reviewed.

PART 2. PRODUCTS

2.01 MATERIALS

A. Permanent Steel Casing

1. For required material grade, see Contract Drawings.
2. Splices
   a. Casing splices, if required, shall be submitted to the Engineer for approval.
   b. Splices shall be made by a continuous full penetration butt weld across the entire cross-section against a tight fitting inside backing ring or using a tight fitting splicer of the same thickness as that of the pipe. Splice welds shall conform to the requirements of AWS D1.1, Structural Welding Code.
   c. If threaded splices are used, the splice shall develop 100 percent of the design capacity of the specified steel pipe cross-section in tension, shear and compression.
3. The nominal diameter of steel pipes at any cross-section along the length of the pipe shall be as indicated on the Contract Drawings. Out of roundness for the pipe shall be in accordance with ASTM A252 and within 1 percent of the pipe diameter.

B. Reinforcing Bars

1. Diameters and grades shall be as shown on the Contract Drawings.
2. A full mechanical connection shall develop in tension or compression at least 125 percent of specified yield strength of the bar.
3. Threadbar reinforcing bars shall be spliced using approved threaded couplers which develop the ultimate tensile strength of the bars without evidence of any failure and jam nuts furnished and installed in accordance with the manufacturer's instructions. Bar couplers shall be of the same grade as that of the Reinforcing bars.

C. Cement Grout

1. The cement grout shall be a pumpable mix consisting of a non-shrink mixture of Portland cement, mineral filler, plasticizer, sand, and water so proportioned and mixed as to provide a grout capable of maintaining the solids in suspension without appreciable water gain, yet which will laterally penetrate and fill any voids in foundation material. The materials shall be so proportioned as to provide a hardened grout having a minimum ultimate compressive strength of 3,000 psi in seven days and the required compressive strength shown on the Contract Drawings in 28 days. The mix design shall also conform to the following:
   a. Substitute either fly ash or slag at the minimum rate of 25 percent by weight of cement. The maximum rates of substitution shall be 30 percent for fly ash and 40 percent for slag. Fly ash and slag substitution in the same mix may be permitted upon approval by the Engineer.
2. Chlorides from any source will not be permitted in the grout mix.
3. Cement shall conform to ASTM C150, Type II, III, or V.
4. Sand shall conform to ASTM C33, Size No. 1.
5. Fly Ash: Conforming to ASTM C311 and ASTM C618, Class F or Class C, except the maximum loss on ignition shall be less than 4 percent.
6. Slag: Conforming to ASTM C989, Grade 120.
7. Mixing water shall be clean, potable, and free from substances that may be injurious to cement and steel.
8. Mineral filler shall be finely powdered siliceous material that will chemically react with calcium hydroxide in the presence of moisture at ordinary temperatures to form compounds possessing cementitious properties.
9. Plasticizer shall be a compound that will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the cement mortar.
10. Expansive admixtures shall only be added to grout used for filling sealed encapsulations and pile cap covers.
11. Molding and testing of grout specimens shall be in accordance with ASTM C109.

D. Miscellaneous Materials
1. Plates, Shapes and Nuts: See Contract Drawings for material requirements.
2. Centralizers and spacers shall be fabricated from PVC pipe, or material non-detrimental to the reinforcing steel. Wood shall not be used.
3. Centralizers and spacers shall be securely attached to the reinforcement, sized to position the reinforcement within one-half inch of plan location from the center of pile, to allow tremie pipe insertion to the bottom of the drill hole, as well as to permit grout to freely flow up the drill hole and casing and between adjacent reinforcing bars.

PART 3. EXECUTION

3.01 GENERAL

A. Prior to drilling, locate existing underground utilities in the areas of work. Furnish and install adequate means of support and protection for utilities during excavation, drilling, grouting, and backfilling operations.

B. Prior to bringing drill equipment onto the site, examine the existing site conditions to ensure that all equipment selected for pile installation can operate properly for the intended purpose. Use the Work Plan, defined in Appendix "A", approved by the Engineer, describing the construction methods and equipment to be used for pile installation. Deviations from the Work Plan must be submitted to the Engineer and approved prior to implementation.

C. Piles shall be furnished and installed in such a manner as to ensure that no damage is sustained either to adjacent structures or to previously formed piles. The Contractor shall be responsible for damage to existing structures and utilities and shall repair or replace the structures or utilities to the satisfaction of the owner at no additional cost to the Authority.

D. The methods selected for this work shall be such that they will provide suitable protection to the public.

3.02 BORING AND SAMPLING

A. Before commencement of pile installation, perform an exploratory test boring at each load test pile location and at the center of each pier column foundation where micro-piles are to be used, and at locations directed by the Engineer. The exploratory borings shall extend to a minimum of 5 feet below the anticipated bottom of rock socket, which is to be constructed entirely within the competent rock. Competent rock shall be as defined in Section 3.05B.13. If test cores do not meet the criteria of "Competent Rock" the exploratory test boring shall be extended to a maximum depth of 40 feet below the top of rock, which shall be determined by the Engineer.

B. The exploratory borings shall be performed by an independent drilling firm with a minimum of 10 years drilling experience and approved by the Engineer. All borings shall be inspected and logged by a geologist or geotechnical engineer with a minimum of 5 years of boring and rock coring inspection and logging experience and approved by the Engineer. Notify the Engineer a minimum of 48 hours prior to the commencement of any exploratory test boring. The Engineer will be present during the exploratory test boring to observe the borings and sampling operations, and logging procedures. Provide necessary accommodation and assistance to the Engineer during his presence.

C. The exploratory test borings shall include both soil sampling and rock coring and shall consist of NX or NQ size triple tube split inner core barrel starting at the ground surface. Split spoon samples shall be obtained with Standard Penetration Tests at 5 foot intervals in soil and completely weathered or decomposed rock deposits in accordance with ASTM D1586. Coring shall be performed in accordance with ASTM D2113. The exploratory test borings shall be cased from the ground surface to the final core run.

D. It is important that the percentage of recovery of the cores be as high as possible; the Contractor shall regulate the speed of the drill and remove the core frequently to maintain a maximum percentage of recovery, and special care shall be taken where the character of the rock being penetrated is uncertain.

E. Core shall be carefully removed from the core barrel, classified, and stored in well-constructed wooden core boxes with secure covers to prevent disturbance to the core during handling. The core samples will become the property of the Authority, and the Contractor will provide a spot on site for their storage until the Authority can take possession. The Contractor shall be responsible for delivering the core boxes and soil samples to a storage site identified by the Authority.

F. The Contractor shall exercise particular care in recording water losses, rod jerks, rod drops, changes in rotation speed and other unusual coring observations that will serve to supplement the core record and data regarding the nature and the extent of any fracturing, soft seams, voids and other characteristics of the formations being cored. The exploratory test boring logs shall include rock description, rock quality designation (RQD), and rock recovery for each core run. Soil shall be classified in accordance with the requirements of ASTM D2487. The rock shall be logged in conformance with the recommendations and terminology presented in the ISRM, "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses".

G. RQD is a modified core recovery percentage in which the pieces of core over 4 inches long are summed and divided by the length of the core run. Note that only those pieces of rock that are classified as moderately weathered to unweathered shall be considered in the RQD count.

H. The result of the exploratory test borings shall be submitted to the Engineer for review before the start of any micro-pile installation. Field logs of the borings shall be submitted to the Engineer by 8:00 a.m. on the next working day after completing each boring; a typed log including color photos of all rock cores shall be submitted to the Engineer within five (5) working days after completing each boring.

I. Fill drill holes with cement grout by tremie method after completion.

J. Provide a minimum 48-hour advance notice to the Engineer before drilling of a boring starts. The Engineer may inspect the boring operation. Provide all necessary assistance as required for the Engineer's inspection.

3.03 PILE LOAD TESTING (VERIFICATION LOAD TESTS)

A. Perform load tests at locations shown on the Contract Drawings or where directed by the Engineer. If additional load tests are required during production pile installation, they shall be scheduled to result in minimum interference to construction operations. The scheduling of load tests shall be as approved by the Engineer. No piles shall be installed within 200 feet of a pile undergoing load testing.

B. Furnish and install test piles in accordance with the provisions of this section and the Contract Drawings, and in accordance with the approved pile installation plan. Use the same construction methods, procedures, equipment, and pile details to be used for the production piles. Notify the Engineer a minimum of 48 hours prior to commencement of test pile installation. Provide necessary accommodation and assistance to the Engineer during his presence. Contractor shall be responsible for locating and protecting existing utilities in the vicinity of the load test.

C. An exploratory test boring shall be performed at each test pile location and the boring log submitted to the Engineer not less than 14 days prior to installation of the test pile.

D. Notify the Engineer a minimum of 48 hours prior to the commencement of any load test. The Engineer will be present during the load test to observe the conducting of the load test, recording and plotting of the test results. Provide necessary accommodation and assistance to the Engineer during his presence.

E. Load test shall not be performed on any pile until a minimum of 10 days has elapsed after installation, or as approved by the Engineer.

F. Load shall be applied to the test pile in increments by means of a hydraulic jack, which reacts against an anchored or deadweight reaction frame. The load supports shall not be closer than 10 feet to the test pile unless approved otherwise by the Engineer. The reaction frame shall be centered on the test pile, and shall be designed to safely resist a minimum of 1.5 times the designated Maximum Test Load of the pile being tested. The Maximum Test Loads are shown on the Contract Drawings.

G. The hydraulic jack shall be of an approved make with a capacity of at least 1.5 times the designated Maximum Test Load of the pile being tested and shall be capable of pushing the pile a minimum of 6 inches. An arrangement of multiple hydraulic jacks or rams shall not be used. The hydraulic jack shall be furnished with a pressure gauge calibrated within the last 3 months.

H. Test piles shall be cut at a distance of 24 inches, plus or minus 6 inches, above the surrounding ground surface, unless otherwise approved by the Engineer. Where necessary, the unsupported length of the test pile shall be braced to prevent buckling without influencing the test result.

I. The cut surface at the top of the test pile shall be level, flat and perpendicular to the long axis of the test pile. Any damaged or unsound material shall be removed from the pile top.

J. Furnish and install all required swivel plates, base plates, load cells, and matching bearing plates as required for pile load tests. A steel bearing plate of appropriate thickness shall be set on top of the pile to distribute the test load uniformly over the entire cross-sectional area of the test pile. The hydraulic jack shall be interposed between the steel plate and the center of the underside of the main girder, or reaction beam, of the loading system. Sufficient clearance shall be provided between the top of the ram and the underside of the reaction beam (or plate) for the placement of an electronic load cell and "ball and socket" plate. A steel plate of suitable dimensions shall be centered on the load cell to distribute the load to the girder, or reaction beam. Contractor shall exercise care not to allow the reaction system to settle onto the pile before extending the hydraulic jack.

K. Both vertical and horizontal movements of the pile head shall be measured with dial gauges. Contractor shall furnish and install, as directed by the Engineer, three micrometer dial indicators, each having a minimum range of 3 inches and graduated to 0.001-inch divisions. The three gauges shall be spaced equally around the pile. Provisions shall be made for free vertical movements should it become necessary to reset the micrometer dials. In addition, furnish and install two micrometer dial indicators to measure horizontal pile head movements in two orthogonal directions.

L. Micrometer dials shall be mounted to one or more steel reference beams furnished and installed by Contractor. Reference beams shall be rigid and supported by piles as approved by the Engineer. Reference beam supports shall be located at a distance of at least 10 feet from the center of the test pile and at least 7 feet from the temporary pile or anchored reaction frame supports. Wood or other materials subject to variations in moisture content shall not be used in reference beams, cross beams, shims, or for any other means of dial support.

M. In addition to micrometer dials, settlement of the test pile shall be determined by means of a taut piano wire drawn across the face of a mirror-mounted graduated scale furnished and installed by Contractor. The scale shall be 6 inches in length, machine divided at 0.02 inch and mounted to a new mirror 3 inches by 6 inches in size, with metal and glass bonding adhesive or plastic electrical tape. The mirror shall be mounted directly upon the face of the test pile as approved by the Engineer and oriented such that its face is parallel with the reference wire. Space shall be provided such that the scale can be read on a horizontal line of sight. The piano wire shall be mounted between the micrometer dial support beams, and shall be fixed at one end and threaded over a smooth pulley at the other end with about a 5-pound weight to maintain uniform tension. The wire shall be level and within 3/4 inch of the mirror.

N. In addition, settlement of the test pile shall be monitored using surveyor's level or laser beam in accordance with ASTM D1143.

O. The entire measuring apparatus shall be protected against rain, wind, direct sunlight, frost, and any other disturbances, which might affect the reliability of the settlement and instrumentation observations. Contractor shall furnish and install temporary lighting and suitable heat as necessary and required by the Engineer during the conduct of the test.

P. Prior to the start of each load test, submit calibration records for the pressure gauges, jacks, and micrometers for approval by the Engineer.

Q. An approved load cell with a capacity of at least 1.5 times the designated Maximum Test Load of the pile being tested shall be utilized for measuring the load at the pile head.

R. Load cells shall be of the electronic type with accuracy to one percent under full test load. The load cell and hydraulic jack shall be calibrated individually and in combination not more than 21 days before their use for loading purposes, and calibration reports shall be submitted to the Engineer for review prior to load testing. Recalibration shall be done when directed by the Engineer.

S. During each load test, furnish manpower on a 24-hour-per-day basis to regulate the loads and record the results. Load testing equipment and procedures shall conform to ASTM D1143 except Section 8 loading procedures shall be deleted and replaced with the following provisions, unless directed otherwise by the Engineer:

1. Unless plunging failure occurs first, load the test pile to the Maximum Test Load shown on Contract Drawing, apply the load in increments of 12.5 percent of the Required Nominal Compressive Resistance. Plunging failure shall be considered to occur when continuous jacking is required to maintain the applied load, or when the pile displacement reaches 2 inches, whichever occurs first.

2. Apply and hold each incremental load according to the criteria specified below. Record and plot the average dial gauge readings of pile butt settlement in inches versus logarithm of elapsed time in hours measured from the application of the most recent load increment. Take and record pile settlement readings at the following intervals after the application of each load increment: 0.5, 1, 2, 4, 8, 15, 30 minutes, and each 30 minutes thereafter until completion of the current load increment. Before making any settlement readings, check the applied load by observing the pressure of the hydraulic jack and the load cell; maintain the load by operating the pump as required.

3. For load increments other than the Maximum Test Load, apply and hold each incremental load for at least one hour. Maintain each load increment until the rate of settlement is not greater than 0.01 inch over a period of one hour, but not longer than two (2) hours.

4. The Maximum Test Load shall remain in place for a minimum of 12 hours following the application of the load. At the end of the 12-hour holding period:

   a. If the plotted pile settlement rate is less than 0.01-inch over a period of one hour and the settlement rate is decreasing with log time, proceed to remove the test load.

   b. If the pile settlement rate exceeds 0.01 inch over a period of one hour or if the settlement rate is not decreasing with log time, hold the Maximum Test Load until the plotted settlement curve demonstrates a stable (non-increasing) settlement rate of not more 0.03 inch per log cycle of time, or until a total hold time of 24 hours is reached, whichever occurs first. Proceed to remove the test load.

5. After the required holding time, remove the Maximum Test Load in decrements of 12.5 percent of the Maximum Test Load with 1 hour between decrements. Maintain zero load until rate of rebound is not greater than 0.01 inch per hour, or four hours, whichever occurs first.

6. If pile plunging failure occurs, continue jacking the pile until settlement equals 2 inches, as measured at the pile butt. Then stop pumping and allow pile load to decrease until pile displacement rate stabilizes. Hold the pile at this load for a period of one hour, then remove load in decrements as specified above.

T. Prepare a load test report after each load test according to the requirements of the FHWA SA-91-042, Static Testing of Deep Foundations, Appendix C.

U. The Engineer will review results of all load tests before beginning production piles at each approach structure (NY and NJ). Contractor shall not proceed with production piles until all load tests at the particular approach have been reviewed and approved by the Engineer. Allow four weeks for the Engineer's review.

V. If the pile load test does not meet the acceptance criteria shown on the Contract Drawings, the cause(s) shall be established, and Contractor shall revise the micro-pile rock socket length and/or installation procedure and retest the new system, after the Engineer's review and approval. Contractor shall perform any additional load tests at no additional cost to the Authority.

W. Piles that do not meet the acceptance criteria during the load test shall not be retested.

X. Upon satisfactory completion of load testing, the tested pile and reaction piles or anchors, if used, shall be cut-off a minimum of three feet below the existing ground surface, unless otherwise directed by the Engineer, and all equipment, frames, loading platforms, cut-off segments, deadweights, and other material related to the work specified herein shall be removed from the site. All salvaged materials shall become the property of Contractor.

Y. Upon completion of the Work at each load test site, Contractor shall furnish all materials and shall restore all pavements, walks and curbing, inclusive of all gravel, asphalt, and brick or concrete types, disturbed during the course of work included under this contract, to a condition equal to or better than at his entry, and to the satisfaction of the Engineer.

Z. Four copies of a preliminary test report containing the load-displacement curves and other test data shall be submitted to the Engineer for each load test within three (3) days of completing each load test. Four copies of the final report on each load test, as well as the Contractor's final calculations and recommended production pile and rock socket lengths, shall be submitted to the Engineer within seven (7) days after completion of each load test. The Contractor shall allow four (4) weeks after the completion of all load tests for the review and evaluation by the Engineer on the load test results and the final calculations and recommended production pile and rock socket lengths, provided that on-time submissions were made for these items and for the typed boring log and core photos for the required exploratory test borings as defined herein and on the Contract Drawings. Installation of production piles shall not begin until authorized in writing by the Engineer. The final load test report shall include at least the following items:

1. Tables presenting instrumentation data
2. Plots of load versus displacement, for each stage of the test, including a straight line representing the acceptance criteria defined on the Contract Drawing. The scales of the horizontal and vertical axes of this plot shall be selected such that the straight line representing the failure criteria is plotted at an inclination of about 20 degrees from horizontal.
3. Plot of creep displacements versus logarithmic time for each load increment
4. Description of the test pile details, instrumentation and test procedures
5. Installation records of the test pile and reaction piles or anchors, if used
6. Log of exploratory test boring located at the test pile location

3.04 PILE LOAD TESTING (PROOF LOAD TESTS)

A. If an installed production micro-pile is deemed defective and/or non-conforming, as determined by the Engineer, it shall not be accepted unless a proof load test is conducted and the results are satisfactory.

B. Proof load tests shall be conducted, and results reported, in the same manner as a verification load test, except that the Maximum Test Load shall be seventy percent (70%) of the Required Nominal Compressive Capacity, for the corresponding foundation location, shown on the Contract Drawings, unless otherwise directed by the Engineer.

C. Test loads for the proof load tests shall be applied using the Quick Test loading procedure specified in ASTM D1143.

D. A proof load test shall not be considered accepted unless both of the following criteria are satisfied:

1. Plunging failure as defined in Article 3.03.S.1 shall not occur at or before the Maximum Test Load; and
2. The maximum measured pile head settlement under the Maximum Test Load shall not exceed the elastic shortening of the test pile, computed using 100% of the cased section length plus 50% of the rock socket length.

E. Where a proof load test identifies a defective pile, the proof load test shall be conducted at no additional cost to the Authority, unless it can be demonstrated that the defect and/or non-conformance of the pile are due to unanticipated subsurface conditions.

3.05 INSTALLATION

A. Equipment

1. Furnish and install piles with the equipment needed to satisfy the requirements described herein and on the Contract Drawings. It is Contractor's responsibility to provide drilling methods and equipment capable of attaining the required pile depth and capacity through soil, boulders, observations and rock.
2. The drill casing shall be watertight and of the flush-joint type.
3. The maximum diameter of the cutting shoe, if used, shall not exceed the outer diameter of the drill casing by more than 1/4 inch.
4. Cement grout shall be mixed in an approved high-speed mixer capable of producing sufficient high quality colloidal cement grout to fill each pile without interruption.

B. Installation

1. Pile installation operations shall be performed only in the presence of the Engineer.
2. Provide equipment and methods capable of attaining the required pile depth and capacity. The equipment shall be situated at the proper location such that the final location of the pile will not deviate more than permitted by Article 1.05E of these Specifications.
3. Do not install piles within 15 feet of grouted piles that are less than 24 hours old.
4. Control procedures and operations to preclude undermining, disturbing, inducing movements and vibration to the existing Bayonne Bridge and adjacent structures and utilities that exceed the specified Response Values specified in Specification Section 02212 and as shown on the Contract Drawings. If such values are exceeded, or if any unacceptable damage occurs, implement the required Response Action Plans. Damage shall be repaired to the satisfaction of the Engineer and the facility or utility owners, at no additional cost to the Authority.
5. Perform drilling and excavation in such a manner to prevent collapse of the hole. Before reaching the bedrock, the drill tool shall not be allowed to extend ahead of the end of the drill casing at any time.
6. Advance the pile to bedrock using non-displacement drilling methods, such as
   a. Rotary duplex drilling methods.
   b. "Spinning down" the pipe using a cutting shoe at the bottom of the pipe with separate clean-out of materials from within the pipe.
   c. Other such methods approved by the Engineer that can advance the pipe without pre-drilling ahead of the pipe. Positive circulation or flushing to clean out a drilled hole by water injection and collecting returns upward along the outside of the drill casing will not be allowed. Discharging water or drill spoil onto the ground surface will not be allowed. Use of air to clean the casing will also be prohibited.
7. Drilling casing shall be in intimate contact with the bored hole sides at all times. Sudden or rapid withdrawn and plunge or similar operating procedures that may result in disturbance, collapse or an unsupported drill hole will not be permitted during pile installation.
8. All holes in overburden shall be stabilized by steel casing. Use of bentonite or polymer slurry to stabilize the sides of the drill hole will not be permitted.
9. Conduct drilling and cleaning procedures in such a manner as to prevent ground loss or ground movement beyond the borehole. If a separate drill tool is used for advancing the casing, it shall be located within the casing at all times.

10. If obstructions, such as boulders, are encountered, piling operation shall progress through the obstruction by means of coring, using a tri-cone roller bit, churn drill, or appropriate cutting bit. Use of a down-the-hole hammer (DTHH) will only be permitted to drill through the existing bridge pier foundations adjacent to the railroad, for installing micro-piles at Pier Nos. S7 and S8 and for drilling of the rock socket into competent rock after the casing is seated into the competent rock. Use of DTHH for drilling in the soil overburden or through obstructions above competent rock will be prohibited.

11. The vibration level induced by any approved equipment must not exceed the threshold vibration level specified on the Contract Drawings.

12. Return drill fluid with cuttings shall be controlled by diverters, or other methods approved by the Engineer that produce a closed system allowing all drill spoil to be placed in settling tanks for separation of fluid from solids for eventual disposal.

13. Competent rock is defined as unweathered to slightly weathered rock with a Rock Quality Designation (RQD) of 50% or greater and minimum recoveries of 90% for each 5-ft core run. The rock socket shall begin beneath any moderately to completely weathered or highly fractured rock encountered and may be lower than interpretation of existing borings. The Engineer will be the sole judge as to where top of competent rock adequate to begin the socket has been encountered in the field.

14. The pile casing shall be advanced and seated into competent rock and cleaned of all soil, material and water so as to provide a clean casing for downhole video inspection.

15. After seating the casing in competent rock, the rock socket shall be drilled to the required length by means of coring, using a tri-cone roller bit, or other appropriate rotary cutting bit, and flushed with water until substantially clean of fines. All sockets will be inspected by downhole video camera for approval by the Engineer to ensure that the rock is continuous and unweathered in the socket zone. If required, the socket length shall be increased until video inspection shows the required length in rock is attained.

16. The method of rock socket cleanliness inspection shall include a video inspection camera lowered into the rock socket. Furnish all equipment necessary to conduct the video camera inspection. Operate the camera and supporting equipment under the direction of the Engineer in such a manner as to obtain optimum results from the equipment. The equipment shall be capable of operating in submerged conditions encountered during the inspection. The device shall also be equipped with water jets to flush away any sediment that may exist and expose the rock socket sidewall and base.

17. The video inspection camera shall be used in all test piles and production piles. The rock socket shall be thoroughly cleaned of all loose sediment to the extent possible prior to inspection. The video camera shall be operated such that the optimum clarity of details is obtained and the rock socket side wall and base can be observed. All scanning with the video camera shall be recorded on videotape and/or DVD. After completion of the video inspection, the Engineer will direct whether or not drilling of the rock socket shall be continued to a greater depth or additional clean-out is necessary. All video camera recordings shall be stored in proper containers with dust-tight closures and shall be properly labeled as to pile number along with project and contractor identification. Tapes shall be furnished to the Engineer and shall become the property of the Authority upon completion of the work. The excavated and video-inspected rock socket shall have the Engineer's approval prior to proceeding with grouting.

18. Flush the rock socket clean of all extraneous material immediately prior to installing the steel reinforcing

19. Lower the steel reinforcement along with the centralizers and tremie grout tube to the base of the pile prior to grouting. Partially inserted steel reinforcing shall not be driven or forced into the borehole. The surface of the reinforcement shall be free of deleterious substances such as soil, mud, grease, loose rust, mill scale, ice, or oil that might contaminate the grout or coat the reinforcement and impair bond between the bar and grout.

20. Furnish and install centralizers and spacers attached to the reinforcing bar with a maximum spacing of 10-feet. The uppermost and lowermost centralizer shall be located no more than 5-feet from the top and bottom of the pile, respectively. The centralizers shall be placed such that they permit free flow of grout without misalignment of the reinforcement and the casing.

21. Place grout in the piles by means of a tremie pipe extending to the bottom of the socket. Pump grout through the tremie pipe until uncontaminated grout returns from the top of the casing. Keep the grout agitated prior to placing and place grout within one hour of mixing. Place grout in one continuous operation to prevent cavities, air pockets, and honeycombing or cold joints forming in the grout. If the grouted pile cannot be completed during the scheduled work shift, extend work hours so that the pile is tremie filled with grout without interruption. Construction cold joints will not be permitted in the grouted column.

    a. Each batch of grout shall have the same volume and contain the same whole number of sacks of cement, unless a modification is approved in writing by the Engineer. Materials shall be accurately measured by weight or volume before mixing. Time of mixing shall be not less than three minutes.

    b. The grout shall be agitated continuously. Restrict the time that the grout is held in the mixer or agitator so that the grout will not exceed the initial set time before the pile is completed grouted. The Contractor shall submit the grout set time information with the shop drawings.

    c. If there is a lapse in pumping of grout, the grout shall be re-circulated through the pump or through the mixer drum until it is pumped to the hole.

    d. Mix and place sufficient grout to over pour any laitance from the top of the casing.

22. Drilling more than one hole or incomplete drilling of holes will not be permitted.

23. All incomplete piles that are in progress shall be capped or covered during overnight or weekend breaks for safety and to prevent any objects from falling in.

24. The Engineer will make on-site inspection of the grout placement.

    a. During construction, samples of grout mix selected at random by the Engineer shall be taken daily when grout is placed in piles (six sets of samples per day). The Contractor shall be responsible for such testing, the cost of same deemed to be included in the cost of the piles.

    b. The samples shall be molded, cured in a properly constructed curing box, tested in accordance with ASTM C109, and shall reach a compressive strength after seven days equal to at least 60 percent of the design strength. If this requirement is not met, Contractor shall modify the proportions of the mix subject to the approval of the Engineer. If the required design strength is not attained after 28 days then Contractor shall furnish and install replacement pile(s) as required by the Engineer.

    c. The Engineer may also require the Contractor to modify the mix design if an excessive amount of grout is lost from a pile hole into voids in the in-place materials.

C. Corrections of Deficiencies

1. The Contractor shall notify the Engineer immediately, in writing, if a pile fails to meet any requirement of this Section. Such written notification shall include all information required for the evaluation of remedial measures, including all information required for redesign.

2. If a pile fails to comply with the location or inclination requirements of 1.05 E, the Engineer will calculate the load capacity requirements of that pile or, if in a pile group, each pile in that pile group, based on the actual, "as-built" locations and inclinations. If the calculation indicates that the loading on that pile or, if in a pile group, on any pile in that pile group, corresponds to a Required Nominal Compressive Resistance of 110 percent or more of the specified Required Nominal Compressive Resistance shown on the Contract Drawings, then the Contractor shall perform such remedial work as the Engineer in his sole discretion may approve, including, but not limited to, furnishing and installing additional piles at locations directed by the Engineer and modifying design of the affected piles and/or the pile cap. The Contractor shall perform such remedial work at no additional cost to the Authority.

3. In the case of a pile with deficiency that affects load capacity, as determined in the sole judgment of the Engineer, the pile will be rejected or subject to a proof load test in accordance with Subsection 3.04. If the pile is rejected, the Engineer will determine necessary remedial work including but not limited to furnishing and installing additional piles at locations approved by the Engineer and modifying the design of affected piles and/or pile cap. The Contractor shall perform such remedial work at no additional cost to the Authority.

4. If a pile fails to comply with the requirements of this Section and the Engineer determines in his sole judgment that modification to piles and/or the pile cap, or the installation of additional piles is necessary, the Authority will perform all required redesign and detailing. In such event, the Authority will use its best efforts to complete redesign as soon as practicable. The Contractor shall perform remedial work in accordance with the redesign at no additional cost to the Authority.

5. The Contractor, at his option and at any time that he determines that a pile will not satisfy the requirements of this Section for any reason, including but not limited to encountering an underground obstruction, may, subject to the provisions of this Section, abandon such pile and replace it with a new pile or piles rather than await direction or approval from the Engineer. However, the Contractor, in exercising this option, assumes the risk that such replacement pile or piles have been installed at the proper design location and alignment so as to carry satisfactorily the design load as determined by subsequent analysis performed by the Engineer, in accordance with Article 3.05 C.2. Such abandonment shall be for the Contractor's convenience and subject to all applicable provisions of the Contract.

6. Abandoned piles shall be cut off one foot below bottom of pile cap level and not incorporated in the completed foundation group. Abandoned piles shall not be extracted from the ground.

7. If piles or the pile cap require modification due to changed pile locations, the Authority will provide redesign and detailing. The Contractor shall perform the pile installation, grouting and reinforcing work in accordance with such modified design and details at no additional cost to the Authority

3.06 FIELD TESTS

A. Inspection

1. Cooperate with the Engineer and furnish services as may be required for inspection and obtaining data.

2. Provide all necessary assistance to the Engineer so that the Engineer may keep a set of separate records of each micro-pile installed. The Contractor shall keep a complete record for each micro-pile installed. Such records shall include, but not limited to, the following data:

   a. Date of installation
   b. Pile Number and Required Nominal Compressive Resistance
   c. Type, outside diameter, thickness, length, top and bottom elevations, and grade of casing
   d. Type and size of drill rig and drill tools
   e. Surface elevation of working platform
   f. Depth of drilling in overburden and rock
   g. Depth and elevation of top of competent rock
   h. Depth and elevation of bottom of casing
   i. Depth and elevation of bottom of rock socket
   j. Depth, elevation and description of obstructions encountered
   k. Pile cut-off elevation and as-built location
   l. Total length of pile
   m. Inclination of pile
   n. Size, length, grade and position of reinforcing steel
   o. Elevation and type of reinforcing bar splices used
   p. Grout mix and minimum grout strength
   q. Theoretical and actual volume of grout required to fill pile

r. The time pile installation started, interrupted, resumed and to complete each operation

s. Description of any unusual circumstances affecting installation

t. Results of socket video inspection of the pile

END OF SECTION

SECTION 02376

MICRO-PILES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalogue Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. At least 45 calendar days before planned start of micro-pile constructions (including installation of test piles), submit a micro-Pile Work Plan, signed and sealed by a Professional Engineer registered in the states in which the Work will be performed, that include:

1. All calculations and shop drawings, signed and dated by the originator and checker. Both the originator and checker shall be Professional Engineers registered in the states in which the Work will be performed.
2. Pile details including, but not limited to, inside and outside casing diameters, casing wall thickness, and length of permanent casing, diameter and length of rock sockets, details of pipe used, reinforcement, post-grout tube if used, grouting pressure, and method of pile cutoff
3. Proposed grout mix design, grout strength, documentation from an independent testing laboratory, method of grout placement, and method to measure volume of grout placed to form pile
4. Certified mill test reports properly marked, for the reinforcing steel and steel pipe to the Engineer for review. The ultimate strength, yield stress, elongation and material composition shall be submitted. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.
5. Manufacturer's information, model, size, and type of equipment to be used for installing micro-piles with appropriate manufacturer's literature
6. Details of procedures for pile installation including, but not limited to, consecutive steps and the approximate time required for each step and labor and equipment usage schedule
7. Procedures and equipment for advancing through existing reinforced concrete footings, existing steel reinforcement, concrete debris, timber, bricks, rock fill, boulders, and other potential obstructions
8. Procedures for installation and seating of permanent casings into the competent rock and methods for cleaning out the casings
9. Procedures and equipment for drilling rock sockets and rock socket diameter
10. Methods to flush the drilled hole including the rock socket
11. Details of placement, splicing and centering devices for steel reinforcing
12. The proposed methods to a) monitor verticality of the micro-piles, and b) vertical movements of the steel casing during grouting operations
13. Procedures and equipment for installing micro-piles in variable headroom clearances consistent with the site conditions, workspace and interference from adjacent or existing structures/facilities

14. Methods to be used to control and verify pile position and alignment

15. The methods used to protect nearby structures from damage during construction

16. Procedures for proper removal and disposal of all waste, including groundwater, and spoils including drilling fluid, soil and rock cutting, and grout

17. Shop drawings showing the required working areas as site conditions warrant for installing the piles at the locations shown on the Contract Drawings

18. Details for grouting, including the method, grout tube details, grouting pressure, procedure, and equipment to be used

19. Details for post-grouting, if used, including the method, grouting pressure, grout tube arrangements, procedure, and equipment to be used

20. Layout drawings showing the proposed sequence of pile installation. Coordinate this sequence with the proposed phasing and scheduling

B. List of referenced projects demonstrating past experience in similar piling work to the Engineer no later than 30 calendar days after the Notice to Proceed. The list shall include the name and location of the project, the owner's name and address, the names and telephone numbers of a representative of the designer, and the client for whom the work was performed and who can attest to successful completion of the work. Include a project summary for each referenced project. The project summary shall contain the start and completion dates of the project, subsurface conditions, total number of piles installed, details of piles, installation techniques and any other information relevant to demonstrate Contractor's experience in similar piling work.

C. Resume of the supervisor responsible for the micro-pile installation work, demonstrating the required work experience and qualifications as specified in paragraph 1.06.

D. Verification of welder qualifications where applicable

E. Field logs of the exploratory test borings submitted to the Engineer by 8:00 a.m. on the next working day after completing each boring; and, a typed boring log and color photos of all rock cores submitted to the Engineer within five (5) working days after completing each boring

F. Three weeks prior to commencing load testing, submit shop drawings to the Engineer for review, showing the method of performing load tests, including complete details of equipment, reaction frames, reaction piles and anchors (or deadweight reaction), installation of gauges and the like. Submit calculations for the design of the reaction frame and the capacity of reaction piles (or dead weight reaction load). Submit calibration plots for all jacks and load cells to be used for the load tests. The above information must be approved before purchasing or installing reaction piles and performance of the static load test. Design of the loading system, shop drawings, and calculations for all members, connections, and stiffeners shall be prepared, signed, and sealed by a licensed Professional Engineer registered in the states in which the Work will be performed.

G. Prior to commencement of each load test, submit manufacturer's information for micrometers, jacks and load cells, including make, model number, load range, dimensions, and recent calibration data.

H. Submit load test reports according to the requirements of the FHWA SA-91-042, Appendix C, signed and sealed by a licensed Professional Engineer registered in the states in which the Work is performed. Four copies of a preliminary test report containing the load-displacement curves and other test data shall be submitted to the Engineer for each load test within three (3) days of completing each load test. Four copies of the final report on each load test shall be submitted to the Engineer within seven (7) days after completion of each load test. The final load test report shall include at least the following item

1. Tables presenting instrumentation data
2. Plots of load versus displacement, for each stage of the test, including a straight line representing the acceptance criteria defined on the Contract Drawing. The scales of the horizontal and vertical axes of this plot shall be selected such that the straight line representing the failure criteria is plotted at an inclination of about 20 degrees from horizontal.
3. Plot of creep displacements versus logarithmic time for each load increment
4. Description of the test pile details, instrumentation and test procedures
5. Installation records of the test pile and reaction piles or anchors, if used
6. Log of exploratory test boring located at the test pile location

I. Installation records for each pile. The records shall be submitted within 24 hours after installation is completed for the pile. The records shall include the following, at a minimum:

1. Date of installation
2. Pile Number and Nominal Compressive Resistance.
3. Type, outside diameter, thickness, length and grade of casings
4. Type and size of drill rig and drill tools
5. Surface elevation of working platform
6. Depth of drilling in overburden and rock
7. Depth and elevation of top of competent rock
8. Depth and elevation of bottom of casing
9. Depth and elevation of bottom of rock socket
10. Depth, elevation and description of obstructions encountered
11. Pile cut-off elevation and as-built location
12. Total length of pile
13. Inclination of pile
14. Size, length, grade and position of reinforcing steel
15. Elevation and type of reinforcing bar splices used
16. Grout mix and minimum grout strength
17. Theoretical and actual volume of grout required to fill pile
18. The time pile installation started, interrupted, resumed, and time required to complete each operation
19. Description of any unusual circumstances affecting installation

20. Grout pressures attained if pressure grouting or post-grouting is performed

21. Post-grouting details, when performed

22. Results of pile rock socket video inspection

J. As-built drawings showing the surveyed location of all piles installed and identifying abandoned piles. Actual pile tip elevations, inclinations and pile cutoff elevations shall be shown on the as-built drawings.

END OF APPENDIX "A"

DIVISION 2

SECTION 02378

DRILLED SHAFTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for drilled shaft foundations bearing into soil or rock materials.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO	LRFD Bridge Design Specifications

American Society for Testing and Materials (ASTM International)

ASTM	*Standard Specification for:*
ASTM A148	Steel Castings, High Strength, for Structural Purposes
ASTM A252	Welded and Seamless Steel Pipe Piles
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C33	Concrete Aggregates
ASTM C150	Portland Cement
ASTM C494	Chemical Admixtures for Concrete
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM	*Standard Test Method for:*
ASTM C109	Compressive Strength of Hydraulic Cement Mortars(Using 2-in. or [50-mm] Cube Specimens)
ASTM C311	Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM D1143	Testing of Piles Under Axial Compressive Load
ASTM D1586	Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM D4380	Density of Bentonitic Slurries
ASTM D4381	Sand Content by Volume of Bentonitic Slurries
ASTM D6760	Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing

ASTM	*Standard Practice for:*
ASTM D2133	Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
	American Concrete Institute (ACI)
ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI SP-66(04)	ACI Detailing Manual-2004
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 336.1	Specification for the Construction of Drilled Piers
	American Welding Society (AWS)
AWS D 1.1	Structural Welding Code - Steel
AWS D 1.4	Structural Welding Code - Reinforced Steel
AWS D 1.5	Bridge Welding Code
	American Petroleum Institute (API)
API 13B-1	Recommended Practice for Field Testing Water-Based Drilling Fluids
	Association of Drilled Shaft Contractors (ADSC)
ADSC	Standards and Specifications for the Foundation Drilling Industry
	Federal Highway Administration (FHWA)
FHWA-NHI-10-016	Drilled Shafts: Construction Procedures and LRFD Design Methods
	International Society for Rock Mechanics (ISRM)
ISRM	Suggested Methods For The Quantitative Description of Discontinuities In Rock Masses

1.03 RELATED SECTIONS

A. Section 02110 – Excavation, Staging, Handling, Transportation, and Disposal of Hazardous Materials for the West First Street Site in Bayonne, New Jersey

B. Section 02112 – Excavation, Staging, Handling, Transportation, and Disposal of Non-Hazardous Materials for the West First Street Site in Bayonne, New Jersey

C. Section 02145 – Dewatering

D. Section 02212 – Geotechnical Instrumentation and Monitoring

E. Section 02221 – Excavation, Backfilling and Filling

F. Section 02260 – Special Excavation Requirements

G. Section 02892 – Handling, Treatment and Disposal of Soil Materials (New Jersey)

H. Section 02894 – Handling, Treatment And Disposal of Non-Hazardous Soil Materials (New York)

I. Section 02895 –Disposal of Hazardous Material

J. Section 02897 – Contaminated Materials Management

K. Section 03200 – Concrete Reinforcement

L. Section 03301 – Portland Cement Concrete, Long Form

1.04 QUALITY ASSURANCE

A. Construction Standards: Construct drilled shaft foundations in accordance with applicable requirements of ACI 336.1 and ADSC's "Standards and Specifications for the Foundation Drilling Industry," unless otherwise specified herein or shown on the Contract Drawings.

B. The entity performing the Work of this section shall be a specialty Contractor experienced in drilled shaft foundation construction and Osterberg Cell® load testing with suitable equipment and competent personnel. The Contractor shall submit a list of at least five drilled shaft foundation projects successfully completed in the past five years. The five examples shall contain Contracts with soil or rock conditions, shaft sizes and depths similar to those contained in this project. The Contractor shall submit descriptions of the drilled shaft construction projects to serve as evidence of the capability to construct drilled shafts. The descriptions of the drilled shaft projects shall contain names and telephone numbers of owners' representatives who can verify the Contractor's participation on those projects. These descriptions shall be submitted with the Drilled Shaft Installation and O-Cell Testing Plan and will be evaluated by the Engineer. The Contractor shall also submit qualifications of key staff responsible for shaft installation.

C. Drilled shaft excavations shall be performed with an approved drilled shaft drilling rig. All equipment shall be maintained in a satisfactory working condition and shall be operated by competent and experienced personnel throughout the operation.

D. Conduct layout work for each drilled shaft to lines and levels required and submit final measurements of plan location, shaft diameter, bottom and top elevations, rock socket lengths, deviations from specified tolerances, and other data as required.

1. Record and maintain information pertinent to each drilled shaft as described herein.

2. Submit dimensional record drawings showing actual installed location of each drilled shaft, size and offset dimension and other data as noted herein or as directed. Submit actual top of drilled shaft elevation and vertical control bench mark used for layout. Detail onto mylar sheets of approved size, sealed by a Land Surveyor licensed in the states where the work was performed.

E. Demonstration Drilled Shafts:

1. The Engineer will require sacrificial demonstration drilled shafts to verify the Contractor's methods of shaft installation. For each Approach (NY or NJ), the Demonstration Shaft shall be installed, and accepted by the Engineer, prior to initiating installation of Load Test Shafts and production shafts on that approach. Locate the Demonstration Shafts in accordance with the Contract Drawings, unless otherwise approved by the Engineer. Excavate the Demonstration Shafts to the depths shown on the Contract Drawings. Construct the Demonstration Shafts as specified in Part 3 "EXECUTION". Include Cross-hole Sonic Logging (CSL) as specified in this Section.

2. Failure of the Contractor to demonstrate the adequacy of his equipment, methods, and/or expertise shall be reason for the Engineer to require alterations to the Contractor's equipment, procedures, and/or supervising personnel. Additional Demonstration Shafts shall be installed, as directed by the Engineer to demonstrate correction of deficiencies. Any additional Demonstration Shafts shall be at the Contractor's expense. The procedures proposed for installation of the drilled shaft foundations are to be demonstrated and proven during installation of the Demonstration Shafts. Any inadequacies in the proposed procedures or equipment shall be corrected before proceeding with the Work. If the Demonstration Shafts cannot be installed to the required depth using the intended equipment and procedures, or if the Contractor's procedures and equipment are found inadequate to meet the requirements of this specification, the Contractor shall submit appropriate revisions for the Engineer's approval.

3. Cut-off the concreted Demonstration Shafts 4 feet below finished grade after Cross-hole Sonic Logging is performed and results approved by the Engineer. Restore disturbed areas at the Demonstration Shafts to their original condition.

4. Once approvals have been given to construct Load Test Shafts and production shafts, do not change the personnel, methods, or equipment that were used to construct the approved Demonstration Shafts without written approval of the Engineer.

F. Cross-hole Sonic Logging (CSL):

1. Engage an experienced and qualified independent specialty testing agency to conduct the Cross-hole Sonic Logging (CSL) tests. The CSL testing firm shall have a minimum of 5 years of experience in CSL testing of drilled shafts and must be approved by the Engineer before testing. CSL testing equipment and procedure shall conform to ASTM D6760.

2. Furnish and install CSL test equipment that includes the following components:

   a. A microprocessor-based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses, and printing of CSL logs.

   b. Ultrasonic source and receiver probes that produce measurements with consistent signal strength and arrival time in uniform, good quality concrete.

   c. An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system.

   d. A depth measurement device to determine and record depths.

   e. Appropriate filter/amplification and cable systems for CSL testing.

   f. The data acquisition system shall include a microprocessor for display, storage, and transfer of data. Arrival time data must be displayed graphically during data acquisition.

   g. Information regarding the relative position (depth) of the probes in the tubes must be electronically measured and associated with each CSL signal.

   h. The acquisition system or associated software shall provide report quality

plots of CSL measurements that include identification of each individual test.

i. The acquisition system shall store each log in digital format, with shaft identification, date, time and test details, including the transmitter and receiver gain.

3. CSL Tube Installation:

a. The Contractor shall begin Cross-hole Sonic Logging (CSL) on all demonstration, production, and load test drilled shafts not less than 48 hours after placing concrete in the shaft. Ensure that the testing is completed within 20 days after placing concrete.

b. CSL tubes shall be schedule 40 steel pipe. Ensure that the CSL tubes are watertight and have a round, regular, internal diameter free of defects or obstructions, including any at tube joints, to allow the free, unobstructed passage of 1.3-inch diameter source and receiver probes. The tubes shall be free from corrosion with clean internal and external faces to ensure a good bond between the concrete and the tubes.

c. Ensure that each pipe is fitted with a watertight shoe at the bottom and a removable cap at the top. Attach the pipes securely to the interior of the reinforcement cage. Furnish and install the tubes as near to parallel as possible and at equal spacing around the drilled shaft.

d. Ensure that the tubes extend from not more than 6 inches above the shaft bottoms to at least 3 feet above the shaft tops. If the shaft top is below the ground surface, extend the tubes at least 2 feet above the ground surface.

e. Ensure that the tubes are not damaged during reinforcement steel cage installation. As the cage is being lowered into the shaft, monitor the tubes to ensure that they are vertical and parallel, and that connections remain watertight. After installing the reinforcement cage, immediately fill the tubes with clean water. After the tubes are filled with water, cap or seal the tube tops. Identify each tube by numbers, and note its plan position in the shaft.

f. Before placing concrete, measure and record the tube lengths. Note the stickup of the tubes above the shaft tops.

g. Do not remove the seals or caps until the concrete in the shaft has set. When removing the seals or caps after the concrete has set, ensure not to apply excess torque, hammering, or other stresses that could break the bond between the tubes and the concrete. After the shaft concrete has set, measure and record the top of tube elevations.

4. CSL Testing and Reporting:

a. The Contractor shall perform CSL tests between pairs of tubes. Perform the CSL tests with the source and receiver probes in the same horizontal plane, unless the tests indicate potential defects. Take CSL measurements at depth intervals of 2 inches or less, from the bottom of the tubes to the top of each shaft. Pull the probes simultaneously, starting from the bottoms of the tubes, over a depth measuring device. Remove slack from the cables before pulling to provide for accurate depth measurements of the CSL records. Test all

principle diagonals through the center and between each tube pair around the perimeter of tested shafts. At drilled shafts where the initial CSL testing identifies anomalies, test all remaining tube pairs at no additional cost to the Authority.

b. If the tests indicate potential defects, the Engineer may direct the Contractor to evaluate questionable zone using tomography (source and receiver vertically offset in the tubes). Report to the Engineer defects and anomalies indicated by longer pulse arrival times and significantly lower amplitude/energy signals and conduct additional tests as required to evaluate the extent of such defects. Additional logging including tomography testing shall be performed at no additional cost to the Authority in the event that potential defects or anomalies are detected.

c. The Contractor shall prepare and submit, in the form of a report, four (4) copies of the CSL results to the Engineer within three (3) days of completion of CSL testing at each drilled shaft. The report shall be signed and sealed by a Professional Engineer licensed in the states in which the Work was performed, and it shall include recommendations as to the acceptability, unacceptability, and soundness of the drilled shaft. Include in the report a CSL log for each tube pair tested with analyses of:

- Initial pulse arrival time versus depth.
- Pulse energy/amplitude versus depth.
- Defect and anomaly zones.

The report shall also document at least the following additional information: date shaft concrete was placed; date(s) of CSL testing; name of person performing the CSL testing; length and top elevation of each CSL tube; position of each CSL tube in the drilled shaft cross section, and top and bottom elevations of the drilled shaft.

The Engineer will evaluate the CSL test results and determine whether or not the drilled shaft construction is acceptable. If the Engineer determines that the drilled shaft is acceptable, dewater the CSL tubes and fill with grout. The Contractor's grout mix shall not include calcium chloride based additives.

G. Core Drilling of Drilled Shaft Concrete:

1. The Contractor may be required to core drill drilled shafts that are determined to be unacceptable or have suspected defects by the Engineer based on the CSL tests. The Engineer will determine the number, depths and locations of cores required. Cores shall have a minimum diameter of 3 inches.

2. Keep an accurate coring log, properly mark cores with the depth at each interval of core recovery, and place the cores in a wood crate. Deliver the cores to a storage site identified by the Authority and deliver 3 copies of the coring log to the Engineer within 3 days after completion of coring.

3. The Engineer will notify the Contractor within 10 working days after the core drilling if the drilled shaft is acceptable. If the Engineer determines that the drilled shaft is acceptable, dewater and grout the core holes.

4. If the Engineer determines that the drilled shaft is unacceptable, the Contractor shall submit for approval working drawings proposing corrective measures. Do not begin corrective measures until the Engineer approves the working drawings in writing. Additional CSL testing and coring will be required by the Engineer after the corrective actions are performed to assess the condition of the remediated drilled shafts and confirm the adequacy of the corrective actions.

5. Do not proceed with construction above a drilled shaft until the quality of the shaft, as represented by the core samples and CSL testing, is determined to be acceptable by the Engineer, and the Engineer provides written notification to continue construction.

6. The additional CSL testing, concrete coring, dewatering and grouting shall be performed at no additional cost to the Authority, except in the case that the additional CSL testing and concrete coring demonstrate that the drilled shaft is acceptable, in which case these services will be compensated on a net-cost basis.

M. Osterberg Cell Load Tests

1. Before installing production drilled shafts, but after successful completion and approval of the Demonstration Shafts and the exploratory test borings at each Load Test Shaft location, Osterberg Cell load tests shall be performed on the sacrificial non-production Load Test Shafts as shown on the Contract Drawings. Osterberg Cell load test equipment and procedure shall be in general conformance with FHWA-NHI-10-016. The load tests shall be performed using an Osterberg Load Cell, hereafter referred to as an O-Cell®, installed in the Load Test Shafts as shown on the Contract Drawings. The Osterberg Load Cells, no substitutions permitted, shall be obtained from and the testing performed by the following supplier:

LOADTEST, Inc
2631-D NW 41st Street,
Gainesville, FL 32606
Phone: 1-800-436-2355
Fax: 1-357-378-3934

2. Load Test Shafts shall be installed at locations shown on the Contract Drawings, unless otherwise approved by the Engineer. If a Load Test Shaft location different from the location shown on Contract Drawing is approved, a boring as specified herein shall be drilled at the approved location prior to installation of the Load Test Shaft.
3. Furnish and install O-Cells and load test instrumentation in accordance with the O-Cell supplier recommendations, instructions, and procedure manual(s), as approved by the Engineer. The Contractor shall be responsible for coordinating with the O-Cell supplier to determine and/or verify required equipment, materials, quantities, procedures, and other applicable items necessary to complete the O-Cell load testing shown on the Contract Drawings.
4. The instrumentation for the tests shall be installed by LOADTEST Inc. The O-Cell shall be installed by the Contractor under the direction of LOADTEST Inc. Work under this Section shall be performed in the presence of the Engineer.
5. The Contractor shall furnish, install, and monitor vibrating wire strain gauges. For each Load Test Shaft, in addition to the strain gauges shown on the Contract Drawings, the Contractor shall furnish not less than four (4) additional strain gauges to be installed at locations directed by the Engineer. The strain gauges shall be placed on opposite sides of

the reinforcing cage at the elevations shown on the Contract Drawings, with four (4) gages at each elevation on two orthogonal diameters, unless otherwise directed by the Engineer. Strain gauges shall be Geokon model 4911 vibrating wire strain meters or approved equal. A portable computer and electronic logging equipment shall be furnished to simultaneously monitor strain gauges at time intervals designated by the Engineer.

6. Two LVDT vibrating wire displacement gauges shall be attached to each O-Cell to monitor the expansion and contraction of the O-Cell. In addition, three LVDT gauges shall be mounted on an independent reference beam and set on the top of the Test Shaft to monitor axial shaft displacement.
7. Two telltale rods shall be set on the top of each O-Cell to monitor the displacement of the top of the O-Cell. Two telltale rods shall also be set on the bottom of each O-Cell to monitor the displacement of the bottom of the O-Cell. The telltales shall consist of a 3/8 inch diameter stainless steel rod placed inside a constant ¾ inch diameter pipe and greased for reducing friction and corrosion. The telltale pipe and rod assemplies shall be secured to the reinforcing cage to protect them from damage during concrete placement operations. Individual sections of telltales shall be joint coupled flush so that each rod is of uniform diameter throughout its length. The Contractor shall furnish and install the telltale extensions when directed by the Engineer.
8. After completion of the load tests to the satisfaction of the Engineer, and when authorized in writing by the Engineer, the Contractor shall flush hydraulic fluid from the O-Cells and O-Cell hydraulic lines, and replace with cement grout in accordance with the approved drilled shaft installation and O-Cell testing plan. The Contractor shall also grout any voids remaining outside the O-Cells after completion of the load tests. Cut-off the concreted Load Test Shafts 4 feet below finished grade. Restore disturbed areas at Load Test Shaft to their original condition.
9. The Contractor shall prepare and submit a testing plan which outlines the test set-up, data collection system, and procedures to the Engineer for approval. The instrumentation locations shown on the Contract Drawings are subject to change following the evaluation of the boring data by the Engineer.

    a. The Contractor shall construct the Load Test Shafts for testing using the approved drilled shaft installation techniques as demonstrated with the Demonstration Shafts. When the Load Test Shafts have been excavated, and accepted by the Engineer, a seating layer of concrete shall be placed by an approved method at the base of the drilled shaft. The O-Cell, tell tales, vibrating wire strain gages, hydraulic supply and other attachments shall be assembled. The Contractor shall then furnish and install the O-Cell in the shaft (while the seating concrete is still fluid) so that the O-cell is resting firmly in the concrete. The Contractor shall use the utmost care in handling the placement/test equipment assembly so as not to damage the instrumentation during installation. The Contractor shall furnish and install a reinforcement cage designed for the O-Cell to be mounted.
    b. After seating the O-Cell assembly, the Load Test Shaft shall be concreted in the manner specified for production drilled shafts. At least six concrete compression test cylinders shall be molded from the concrete used in the Test Shaft. At least one of the cylinders shall be tested before the load test and at least two cylinders shall be tested on the day of the load test. The O-Cell test shall not be performed until the concrete is allowed to harden for at least seven (7) calendar days and the concrete achieves a compressive strength of at least 70% of the required 28-day compressive strength.

c. If during the period required to perform the load test, the test apparatus shows any sign of negative effects due to the construction activities, such activities shall cease immediately.

d. The Contractor shall furnish and install dial gages, steel reference beams and reference beam supports to measure axial displacement of the test shafts. The steel reference beams, as approved by the Engineer, shall be attached to independent supports installed into the ground at a clear distance not less than three Test Shaft diameters from the shaft to be tested. The reference beam and reference beam supports shall be covered to protect against exposure to direct sunlight. The initial elevations and displacements during the load test of the top of shaft and the reference beams shall be monitored using optical surveying equipment by a Land Surveyor licensed in the state in which the Work is performed.

e. Dial gauges or LVDTs used to measure shaft base displacement, side shear movement, and shaft compression shall have a minimum travel of 8 inches and be capable of being read to the nearest 0.001 inch division. End bearing movement may be alternately monitored using the LVDTs capable of measuring the expansion of the O-Cell (6 inches). The reference beam shall be monitored for movement during load testing using a surveyor's level.

f. The load test shall be performed by a qualified geotechnical engineer approved in advance by the Engineer. The geotechnical engineer shall have a demonstrated knowledge of load testing procedures, have performed at least five O-Cell load tests within the past four years, and shall be a Professional Engineer licensed in the states in which the Work will be performed.

10. Notify the Engineer a minimum of 48 hours prior to the commencement of any load test. The Engineer will be present during the load test to observe the conducting of the load test, recording and plotting of the test results. Furnish necessary accommodation and assistance to the Engineer during his presence.

11. The O-Cell load testing shall be performed in accordance with the requirements specified herein and as directed by the Engineer.

a. Instrumentation shall be installed as specified herewith.

b. Before load testing begins, the Contractor shall furnish a certificate of calibration for the O-Cell from an approved testing laboratory. The calibration shall have been completed for ranges of proposed loading within the two months preceding the load tests. The certified accuracy of the load cell shall be within 1% of the true load.

c. For each O-Cell load test, the load shall be applied in increments of five percent of the Required Nominal Compressive Resistance shown on the Contract Drawings, until the Required Nominal Compressive Resistance is reached or plunging failure occurs as indicated by the instruments. Plunging failure shall be considered to occur when continuous pumping is required to maintain the applied load, or when the displacement reaches 2 inches upward or 4 inches downward, whichever occurs first. If plunging failure does not occur, increase the test load in increments of 2.5% of the Required Nominal Compressive Resistance until the load capacity of the O-cell is reached or the maximum extension of the O-Cell is reached, whichever occurs first. When the O-Cell will be used for a subsequent loading stage, the Engineer may interrupt the loading sequence at an O-Cell opening of approximately 3 inches, or less. Each load increment shall be maintained for a minimum period of 5 minutes, with complete sets of readings obtained and

recorded from gages and instruments at 1, 2, and 5 minutes after application of the load increment. Each increment of load shall be applied within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the addition of a load increment and the completion of the instrument system readings shall be completed within 5 to 15 minutes. The Engineer may elect to hold the maximum applied load for up to one hour.

d. The load shall be removed in decrements of about 10% of the Required Nominal Compressive Resistance. Each decrement of load shall be removed within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the removal of a load decrement and the completion of the instrument system readings shall be completed within 5 to 15 minutes. The Engineer may also require a reloading cycle with 10 loading increments and five unloading decrements. The final rebound of the shaft shall be recorded for a period up to one hour after the last unload interval.

e. For acceptance criteria of O-Cell load tests, see Contract Drawings.

f. Four copies of a preliminary test report containing the load-displacement curves and other test data shall be submitted to the Engineer for each Load Test Shaft within three (3) days of completing each load test. Four copies of the final report on each load test shall be submitted to the Engineer within seven (7) days after completion of each load test. The Contractor shall allow four (4) weeks after the completion of all load tests for the analysis by the Engineer of the load test data and determination of the final drilled shaft and rock socket lengths, provided that on-time submissions were made for all final load test reports, typed boring log and core photos for the required exploratory test borings as defined herein and on the Contract Drawings. Installation of production shafts shall not begin until authorized in writing by the Engineer. The final test report shall include at least the following items:

1. Tables presenting instrumentation data.
2. Plots of load versus displacement (up and down) for each O-Cell, for each stage of the test.
3. Plots of load along the length of the shaft determined from the strain gage data for at least 10 applied load increments.
4. Plots of creep displacements (up and down) for each load increment.
5. Plot of equivalent top-of-shaft load-displacement curve for the Test Shaft, developed from the load test data.
6. Description of the Test Shaft details, instrumentation and test procedures.
7. Summary of unit friction resistance along the length of the shaft and end bearing resistance.
8. Plots of the end bearing resistance versus displacement and friction/adhesion resistance versus displacement for each segment of the shaft in rock and soil.

1.05 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions:

1. Notify the Engineer and provide owners of adjacent property and utilities notification regarding the commencement of work at least seven days in advance before proceeding with the Work.

2. Protect all adjacent structures and utilities from damage due to the Work. Bridge traffic on the existing Bayonne Bridge and access to site shall be maintained at

all times without interruption, except as approved by Engineer. Prior to excavations for drilled shafts, locate and pre-excavate to expose portions of the existing utilities within the drilled shaft work area, and provide support and protection as necessary so as not to adversely affect the integrity of the utilities due to construction activities. The excavation and support methods shall be subject to the Engineer's approval.

3. Should uncharted or incorrectly charted structures or utilities be encountered during excavation, the Engineer shall be immediately notified and consulted for directions as to procedure. Coordinate with the Authority, and with public and private utility companies in keeping their respective services and facilities in operation. Repair damaged structures and utilities to the satisfaction of the Engineer, structure owner or utility owner at no expense to the Authority.

4. No drilled shaft construction operations shall be performed within five drilled shaft diameters, measured center-to-center, of a previously installed drilled shaft until the concrete has been in place for a minimum of 48 hours, unless it is shown by concrete sample testing that the concrete has reached 60% of the required 28-day compressive strength specified on the Contract Drawings. Furthermore, for at least 48 hours after shaft concrete has been placed, no construction operations that may cause soil movement adjacent to the shaft, other than mild vibrations, shall be conducted. Mild vibration is defined herewith, as the operation of light construction equipment adjacent to the shaft.

5. Control procedures and operations to preclude undermining, disturbing, inducing movements and vibration to the existing Bayonne Bridge and adjacent structures and utilities that exceed the specified Response Values specified in Specification Section 02212 and as shown on the Contract Drawings. If such values are exceeded, or if any unacceptable damage occurs, implement the required Response Action Plans. Damage shall be repaired to the satisfaction of the Engineer and the facility or utility owners at no expense to the Authority.

6. Drilled shaft construction operations shall be performed only in the presence of the Engineer.

7. The Contractor shall be aware that the subsurface conditions may include boulders, cobbles, concrete debris, existing concrete footings, brick, wood, concrete, fractured rock, and other obstructions that must be penetrated during installation of the shafts. No claim for additional costs will be allowed for drilled shaft installation through the obstructions.

B. Alignment and Tolerances

1. Unless otherwise shown on the Contract Drawings, drilled shafts shall be constructed so that the axis of the drilled shaft, measured at the top of the drilled shaft, is within three (3) inches of the location shown on the Contract Drawings.

2. Ensure that the top of shaft elevation of the completed drilled shaft is within minus 3 inches and plus 1 inch of the top elevation as presented on the Contract Drawings.

3. Drilled shafts shall be plumb, to within 1.5 percent of the length based on the total length of the shaft.

4. The bottom of rock sockets shall be flat with a slope no greater than 3/8 inch per ft of bottom.

5. During construction of the drilled shafts, make frequent checks on the plumbness, alignment and dimensions of the drilled shafts and correct immediately any deviation exceeding the allowable tolerances.

6. The reinforcing cage shall be concentric with the drilled shaft excavation within a tolerance of 1-1/2 inches.

7. Steel reinforcing bars shall be no higher than 6 inches above or 3 inches below the elevation shown on Contract Drawings.

8. Minimum concrete cover thicknesses shall be as shown on the Contract Drawings.

9. The diameters of the drilled shaft and rock socket shall not be less than the diameters shown on the Contract Drawings.

10. Tolerance for casings shall be in accordance with American Pipe Institute tolerances applicable to regular steel pipe.

11. Steel reinforcing cage movements during concrete placement: The elevation of the top of the steel cage shall be checked before and after the concrete is placed, and throughout the concrete placement process. The final upward displacement of the rebar cage shall not exceed 2 inches and the final downward displacement shall not exceed 1 inch.

1.06 SUBMITTALS

A. See Appendix A for Submittal Requirements.

B. Review of Drilled Shaft Installation and O-Cell Testing Plan

1. The Engineer will evaluate the Drilled Shaft Installation and O-Cell Testing Plan for conformance with the Contract Drawings and these Specifications. A review meeting between the Contractor, Sub-Contractor and Engineer, will be required after review of the Drilled Shaft Installation and O-Cell Testing Plan, and shall take place at least 15 days before start of Demonstration Shaft installation.

2. The meeting, arranged by the Engineer, will discuss the Drilled Shaft Installation and O-Cell Testing Plan. Within 30 calendar days after receipt of the Plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary in the opinion of the Engineer to satisfy the Contract Drawings and these Specifications.

3. Any part of the Plan that is unacceptable will be rejected and the Contractor shall submit changes for reevaluation. The Engineer will notify the Contractor in writing within 10 working days after receipt of proposed changes of their acceptance or rejection. Approvals given by the Engineer will be subject to trial and satisfactory performance in the field.

4. Shaft construction and O-Cell Testing shall not begin until the Drilled Shaft Installation and O-Cell Testing Plan has been approved by the Engineer. Approval of the Drilled Shaft Installation and O-Cell Testing Plan will not relieve the Contractor of the full responsibility to satisfactorily complete the work as detailed on the Contract Drawings and in these Specifications.

5. Deviations from the Drilled Shaft Installation and O-Cell Testing Plan will not be permitted without the written approval of the Engineer.

1.07 SEQUENCING AND SCHEDULING

A. Once written authorization has been given to construct production shafts, commence drilling and operations at the location as indicated on the Contract Drawings. The commencement of the demonstration, load test and production shafts shall be coordinated with the instrumentation and monitoring requirements for the existing Bayonne Bridge and adjacent structures.

B. Schedule drilling, installation of reinforcing steel and concrete placement so that each excavated shaft is concreted no more than 12 hours after the rock socket is excavated and approved.

C. Prevent heavy vibration or excessive wheel loads within the immediate vicinity of any shaft excavation and newly completed drilled shaft. Maintain stability of the excavation side walls at all times and prevent collapsing and sloughing of material into the excavation.

PART 2. PRODUCTS

2.01 MATERIALS

A. Concrete:

1. All material, proportioning, mixing and transporting of concrete shall be in accordance with the requirements for Self-Consolidating Concrete in Specification Section 03301, Portland Cement Concrete. Concrete shall have a minimum 28 days compressive strength as shown on the Contract Drawings.

B. Slurry:

1. Controlled slurry used for construction of the drilled shafts shall have the following properties:

Item To Be Measured	Results At 68 Deg. F_	Test Methods
Density, Before Concreting For Slurry 1 Foot From Shaft Bottom	64 pcf Max. Polymer Slurry and Water Slurry 75 pcf Bentonite Slurry	API 13B, Section 1 (Mud Balance) ASTM D4380
Marsh Funnel Viscosity, for Entry Slurry	40 To 90 Sec/quart Polymer Slurry 28 To 45 Sec/quart Bentonite Slurry	API 13B, Section 2 (Marsh Funnel and Cup)
Sand Content by Volume, Before Concreting for Slurry 1 Foot from Shaft Bottom	0.5% Max. Polymer Slurry 1% Max. Water Slurry 2% Max Bentonite Slurry	API 13B, Section 4 (Sand Screen Set) ASTM D4381
pH, During Excavation	8 To 11	API 13B, Section 6 (Paper Test Strips or Glass Electrode Ph Meter)

2. The controlled slurry shall be obtained from sources approved by the Engineer. The slurry shall be mixed, stored, and transported using equipment made for these purposes.

C. Reinforcing Steel:

As shown on the Contract Drawings.

D. Permanent Casing:

As shown on the Contract Drawings.

E. Steel Cutting Shoe:

ASTM A148, Grade 90-60.

2.02 EXCAVATING AND DRILLING EQUIPMENT

A. Furnish excavating and drilling equipment with adequate capacity, including power, torque, and down thrust to excavate a hole of the maximum diameter and to a depth of 20 percent beyond the maximum depth shown on the Contract Drawings. Use rotary drilling tools for rock excavation below the bottom of casing. Furnish excavation and over-reaming tools of adequate design, size, and strength to perform the Work indicated.

B. When the material encountered such as boulders or obstructions cannot be drilled using conventional earth augers or digging buckets, special drilling equipment shall be furnished including rock core barrels, rock drilling tools, and other equipment as necessary to construct the shaft excavation to the size and depth indicated. Blasting will not be permitted.

PART 3. EXECUTION

3.01 GENERAL

1. Advance drilled shafts in conformance with the requirements on the Contract Drawings and these Specifications. Submit a Drilled Shaft Installation and O-Cell Testing Plan showing proposed procedures and methods of advancement of the drilled shafts to the Engineer for approval prior to drilled shaft construction.
2. Only rock coring or drilling equipment shall be used to penetrate boulders, cobbles, decomposed rock, debris or other hard material. Blasting will be prohibited. The use of impact equipment such as drop chisels, churn drills, impact hammers, or hoerams, etc., will be prohibited.
3. Instrumentation and monitoring and implementation of required Response Action Plans during drilled shaft installation shall be performed as per Specification Section 02212, titled "GEOTECHNICAL INSTRUMENTATION AND MONITORING" and the Contract Drawings.
4. Do not excavate a shaft if an adjacent shaft is open unless the Engineer's written approval is obtained. Once the excavation of a shaft has begun, do not stop the excavation until the excavation is completed. If the excavation is stopped for more than 24 hours, maintain shaft stability as detailed in the Drilled Shaft Installation and O-Cell Testing Plan submitted and approved by the Engineer.

3.02 INSTALLATION

A. DRILLED SHAFT EXCAVATION

1. The design of drilled shafts is based on ground resistance to lateral and vertical loading. Excavation for drilled shafts shall be advanced by methods approved by the Engineer which do not permit loss of ground, will not adversely affect existing utilities and adjacent structures, and will not adversely affect the performance of the completed drilled shafts.
2. All drilled shafts shall have a permanent casing which shall be installed into the top of competent rock elevations shown on the Contract Drawings unless otherwise approved by the Engineer. The casing shall be adequately seated into the competent rock to prevent leakage of water or soil material into the drilled hole. The use of vibratory hammers to advance the casing is prohibited. Ensure that permanent casings are clean, round, straight, and free of weld breaks and holes that would allow passage of water or plastic concrete.
3. Ensure permanent casings are continuous between the top and bottom elevations shown on the Contract Drawings.
4. The drilled shaft excavations shall be of the sizes and dimensions and shall be carried to the depths shown on the Contract Drawings.
5. Drilled shaft excavations in the dry will not be permitted.
6. When using slurry to construct drilled shafts, the Contractor may use mineral or polymer slurries. When excavating within casing and in competent rock after seating the casing at the top of competent rock, water may be used as the drilling fluid provided excavation stability is maintained. Slurry shall conform to the requirements given in Section 2.01.B. Drilling slurry shall be maintained at a minimum of five feet above the ambient ground water table at all times. Slurry shall be cleaned prior to concrete placement by circulation to meet the requirements given herein in Section 2.01.B and to control uniformity and remove coarse materials. Submit plan for use of slurry for Engineer's approval.
7. Ensure the slurry suspension requirements are met, as specified in the table in Section 2.01. Before placing concrete, take slurry samples using a sampling tool approved by the Engineer. Test slurry samples from the bottom of the shaft and at intervals not exceeding 10 feet up the slurry column in the shaft, until 2 consecutive samples produce acceptable values for density, viscosity, sand content, and pH at each sampling depth. When slurry samples are unacceptable, take corrective actions. Do not place concrete until the slurry is re-sampled and test results are approved by the Engineer.
8. If the slurry remains in the shaft for more than 8 hours or if caking develops, roughen or re-ream the shaft, inspect bottom cleanliness, and perform new slurry testing before concrete placement.
9. Permanent casing shall be used to support the sides of the excavation and seal off the inflow of ground water. All casing shall be advanced by methods that do not create void space outside the casing. Drilling ahead of the casing will not be allowed. In soils that are sensitive to disturbance, in the opinion of the Engineer, the casing shall be advanced by methods that do not disturb or displace the adjacent ground, including cleaning out the casing as it is advanced to prevent formation of a soil plug. Steel casing shall be flush-joint type with sufficient strength to withstand handling stresses, concrete pressure, and surrounding earth and/or fluid pressures. The casing shall be clean and watertight. The outer diameter of the casing shall not be less than the specified diameter of the completed drilled shaft.

10. All excavated materials shall be disposed of away from the construction site. Procedures for handling, transport, reuse, temporary stockpiling and testing, if required, and disposal of the excavated materials and drilling fluid shall be as shown on the Contract Drawings and described in pertinent environmental Contract Specification sections. Disposal of drilling fluid and water in storm drains is not permitted.

11. Approved cutting shoes of hardened steel shall be welded to the bottom of each steel casing. In drilled shafts that are to be socketed into rock, the casing shall be advanced sufficiently into the rock so as to prevent inflow of soil.

12. When advancing through boulders, decomposed rock or other hard material overlying sound rock, care shall be taken to prevent damage to the cutting shoe or deformation of the casing.

13. Rock sockets below the permanent casing shall be drilled into the competent rock to the depths necessary to provide the required length of socket as shown on the Contract Drawings unless otherwise directed by the Engineer. Drilling of rock sockets shall be performed by using equipment such as a full-face drill, rock auger, or core barrel. The use of drop chisels, churn drills, impact hammers, or hoerams, etc., is prohibited. Blasting is prohibited. The Contractor shall remove all rock fragments, soil or other foreign matter so as to provide a clean bearing surface at the bottom, as specified herein.

14. The estimated drilled shaft length and top and tip elevations of the rock socket in competent rock shown on the Contract Drawings has been estimated based on test borings drilled during the design phase of the project. The actual top of the rock socket and the final tip elevation may vary in the field. The elevation of the rock and the final tip elevation of each drilled shaft will be determined by the Engineer based on the exploratory borings performed by the Contractor as specified in Section 3.06 and the results of the O-Cell testing and the actual drilling of the drilled shafts as specified herein. The Engineer will be the sole judge as to where top of competent rock adequate to begin the socket has been encountered in the field.

15. Competent rock is defined as unweathered to slightly weathered rock with a Rock Quality Designation (RQD) of 50% or greater and minimum recovery of 90% for each 5-ft core run. The rock socket shall begin beneath any moderately to completely weathered or highly fractured rock encountered and may be lower than what is shown on the Contract Drawings.

16. Unless otherwise approved by the Engineer, ensure that at least 50 percent of the base of each shaft has less than 1/2 inch of sediment at the time of concrete placement. Ensure that the maximum depth of sediment or debris at any place on the base of the shaft does not exceed 1-1/2 inches.

17. Confirm shaft cleanliness immediately before the start of concrete placement.

18. The method of shaft cleanliness inspection shall include a video Mini-SID lowered into the shaft. Furnish all equipment necessary to conduct the camera inspection. Operate the camera and supporting equipment under the direction of the Engineer in such a manner as to obtain optimum results from the equipment. The equipment shall be capable of operating in submerged conditions encountered during the inspection. The equipment shall include feeler gauges housed within the bell to estimate the amount of sediment at the base of the shaft to within ¼-inch. The device shall also be equipped with water jets to flush away any sediment that may exist and expose the shaft base. The Mini-SID shall be a rugged steel device that contains a

video camera and probing tool. The Mini-SID, no substitution permitted, is available from:

GPE, Inc.
4509 N.W. 23rd Avenue, Suite 16
Gainesville, FL 32606
Telephone: 352-372-2403
Fax: 352-372-3757
Website: http://www.gpe.org/

19. The mini-SID shall be used in the Demonstration Shafts and in all load test and all production drilled shafts. Mini-SID inspection shall be conducted at five (5) locations within the shaft; four (4) equally spaced around the perimeter and one (1) at the center. The excavated shaft shall be thoroughly cleaned of all loose sediment to the extent possible prior to inspection. The Mini-SID shall be operated such that optimum clarity of detail is obtained and the drilled shaft base can be observed. All scanning of Mini-SID shall be recorded on videotape and/or DVD. After completion of the Mini-SID inspection, the Engineer will direct whether or not drilling of the shaft shall be continued to a greater depth or additional clean-out is necessary. All Mini-SID recordings shall be stored in proper containers with dust-tight closures and shall be properly labeled as to shaft number along with project and contractor identification. Tapes shall be furnished to the Engineer and shall become the property of the Authority upon completion of the work. In addition, a written inspection log shall be submitted to summarize the Mini-SID bottom inspection. The log form will be subject to the approval of the Engineer. The excavated shaft shall have the Engineer's approval prior to proceeding with concreting.

20. The general conditions of the side walls of the sockets shall be inspected by downhole video camera for approval by the Engineer to ensure that the rock is continuous and unweathered in the socket zone. Furnish all equipment necessary to conduct the video camera inspection. Operate the camera and supporting equipment under the direction of the Engineer in such a manner as to obtain optimum results from the equipment. The equipment shall be capable of operating in submerged conditions encountered during the inspection. The device shall also be equipped with water jets to flush away any sediment that may exist and expose the rock socket sidewall and base. The video inspection camera shall be used in all demonstration, load test and production drilled shafts. The rock socket shall be thoroughly cleaned of all loose sediment to the extent possible prior to inspection. The video camera shall be operated such that the optimum clarity of details is obtained and the rock socket sides and base can be observed. All scanning with the video camera shall be recorded on videotape and/or DVD. After completion of the video inspection, the Engineer will direct whether or not drilling of the rock socket shall be continued to a greater depth or additional clean-out is necessary. All video camera recordings shall be stored in proper containers with dust-tight closures and shall be properly labeled as to shaft number along with project and contractor identification. Tapes shall be furnished to the Engineer and shall become the property of the Authority upon completion of the work. The excavated and video-inspected rock socket shall have the Engineer's approval prior to proceeding with concreting.

21. Furnish equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment of the shaft excavation shall be determined by the Contractor under the observation and direction of the Engineer. Check the dimensions and alignment of the shaft during casing installation and excavation, as well as after excavation. Any device used to check dimensions and

alignment shall be furnished by the Contractor and inserted into the excavation to full depth. Generally, the alignment and dimensions may be checked by the following methods as necessary.

a. Insert a rigid rod or pipe assembly with several 90-degree offsets equal to the shaft diameter into the shaft excavation for alignment and dimension checks.

b. Use electronic calipers.

c. Other methods approved by the Engineer.

22. The depth of the shaft during drilling shall generally be referenced to appropriate marks on the Kelly bar or other suitable methods approved by the Engineer. Final shaft depths shall be measured with a suitable weighted tape or other approved methods. The final shaft depth shall be determined a) after completion of bottom cleaning operations, b) immediately following installation of the reinforcement cage, and c) immediately before concrete placement.

B. DEWATERING:

1. "Wet" Shafts

a. Drilled shafts shall not be dewatered, and shall be considered a "wet" drilled shaft. A static head of water or slurry shall be maintained in the drilled shaft not less than 5 feet above the groundwater level. For final shaft bottom cleaning, all foreign material shall be removed from the drilled shafts by an airlift. This process shall be continued until the water runs clear and there is no intrusion of soil or rock materials into the socket.

b. In cases where the ground water level is higher than the top of drilled shaft, a watertight extension shall be added to the top of the drilled shaft to permit a full static head of water to develop in the extension before proceeding as above.

C. REINFORCING STEEL

1. Reinforcement Steel: The reinforcing steel cage, consisting of longitudinal bars, ties, cage stiffeners, spacers, centralizers, and other necessary appurtenances, shall be completely assembled and placed as a single unit immediately after the shaft excavation is inspected and accepted, and before concrete placement. The reinforcing steel in the shaft shall be securely tied and supported so that the cage will remain within allowable specified tolerances. Internal stiffeners shall be removed as the cage is placed in the drilled shaft hole so as not to interfere with the concrete placement.

2. Spacers: Concrete wheel spacers or other approved non-corrosive wheel-type spacing devices shall be used at sufficient intervals near the bottom, and at intervals not exceeding 10 feet up the shaft, to ensure concentric spacing for the entire cage length. A minimum of one spacer per 30 inch of circumference of cage, with a minimum of three at each level shall be used. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to maintain the proper annular space between the outside of the reinforcing cage and the side of the excavated hole as detailed on the Contract Drawings, or otherwise proposed in the Drilled Shaft Installation and O-Cell Testing Plan and approved by the Engineer. The spacers shall be in the form of wheels or rollers; block or sled type spacers will not be permitted. Metallic spacers will not be permitted.

3. Cage Supports: Furnish and install cylindrical concrete feet (bottom supports) or other approved non-corrosive spacing devices to ensure that the bottom of the cage is

maintained at the proper distance above the base as detailed on the Contract Drawings. Metallic bottom supports will not be permitted.

4. Cage Extension: If the drilled shaft excavation is extended to an elevation lower than the bottom elevation shown on Contract Drawings, reinforcing cage length shall also be extended by the same amount. Cages may be extended at the bottom elevation shown on Contract Drawings by lap splicing additional longitudinal bars, per planned cage requirements, of sufficient length to provide a compression splice, 4 feet in length, plus the required extension. Hoops for the extension shall be spaced the same as shown for other hoops. Any additional splices of the cage above the bottom elevation shown on Contract Drawings shall develop full strength of the bars that it connects, and must have prior approval of the Engineer. Stiffeners, spacers, CSL tubes, and other appurtenances shall also be extended as required.

5. Cage Location Tolerances: The elevation of the top of the steel cage shall be checked before and after the concrete is placed, and throughout the placement process. If the final upward displacement of the rebar cage exceeds 2 inches or if the downward displacement exceeds 1 inch, the drilled shaft will be considered defective, and unacceptable. Corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional shafts shall be constructed until the Contractor has modified his rebar cage support and concrete placement procedures in a manner satisfactory to the Engineer.

D. CONCRETE PLACEMENT

1. Immediately prior to positioning the reinforcing cage or structural steel core, clean bottom of drilled shaft excavation and inspect the shaft bottom as specified in 3.02.A.

2. Concrete shall be placed in accordance with the requirements for Self-Consolidating Concrete in Specification Section 03301 titled "Portland Cement Concrete" except as modified herein.

3. Concrete shall be placed using a watertight concrete pump line or a tremie pipe from the bottom of the excavation upward so as to avoid segregation. Concrete shall not be allowed to fall freely through slurry or water. No air, water, or slurry shall be injected into the shaft during concrete placement. A disposable foam or rubber plug or pig shall be used in the concrete pump line or tremie pipe to separate the fresh concrete from the slurry at the start of concrete placement. The plug shall be placed in the concrete pump or tremie line at the hopper end, not the discharge end. The plug shall be inserted so that the first flow of concrete pushes the plug out of the pipe and prevents slurry mixing and contamination as the initial concrete travels down the pump line or tremie pipe. The concrete pump line or tremie shall consist of a tube constructed in sections having flanged couplings fitted with water-tight gaskets. The means of supporting the concrete pump line or tremie shall be such as to permit free movement of the discharge end over the entire cross-section of the shaft and to permit its being lowered rapidly when necessary to choke off or retard the flow. The tremie shall be filled by a method that prevents washing of the concrete. Maintain the concrete level at the top of the drilled shaft until the concrete has set.

4. The discharge end of the tremie or pump line shall be constructed to permit the free radial flow of concrete during concrete placement. At the start of concrete placement, the discharge end of the tremie or pump line shall be positioned as close as possible to the base of the shaft excavation, but not more than nine (9) inches, to prevent mixing of concrete with the slurry or water in the shaft. Throughout the underwater concrete placement operation, the discharge end of the tube shall remain submerged in the concrete at least ten (10) feet and the tube shall always contain

enough concrete to prevent water from entering. The concrete placement shall be continuous until the work is completed, resulting in a seamless, uniform shaft. If at any time during concrete placement, the tremie or pump line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft shall be considered defective. In such case, remove the reinforcing cage and concrete; complete any necessary sidewall removal directed by the Engineer, and repeat concrete placement in the shaft. All costs of removing the concrete and the reinforcement cage, and for repeating the concrete placement, shall be the responsibility of the Contractor.

5. If the concrete placement operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the shaft contains no voids, defective concrete or horizontal joints. If testing reveals voids, defective concrete, or joints, repair them or replace the shaft to the satisfaction of the Engineer at no expense to the Authority. Responsibility for coring and testing costs shall be in accordance with this Specification.

6. This procedure shall be applied without exception as necessary to avoid injecting any air, any water, any slurry, or any concrete that has flowed through a line filled with air, water, or slurry into the shaft concrete. The Contractor must supply a concrete mix that will maintain workability over the planned placement time as demonstrated by trial mix and appropriate testing methods as specified for Self-Consolidating Concrete in Section 03301 – Portland Cement Concrete. Conform to all requirements for the Self-Consolidating Concrete testing as specified in Section 03301.

7. Final concrete placement elevation and shaft top preparation details shall be as shown on the Contract Drawings.

3.03 STEEL CORES

A. Not Used.

3.04 WELDING AND SPLICING

A. Perform all welding in accordance with requirements for shielded metal arc welding of AWS D1.1 for buildings or D1.5 for bridges and other structures.

B. Only use welders qualified by tests prescribed in AWS D1.1 or D1.5, as applicable.

C. Unless stricter requirements are shown on the Contract Drawings, splice sections of permanent drilled shaft casing with approved full penetration butt weld to develop 100 percent of the bending capacity of casing section being spliced. Both casing ends shall be square cut and seated to bear. Use an approved jig or alignment device during welding to maintain the required straightness of casing specified in 1.05 B.

3.05 FIELD QUALITY CONTROLS

A. Additional integrity testing may be performed by the Engineer. Provide all necessary assistance required by the Engineer for the additional integrity testing if performed.

B. Inspection

1. Cooperate with the Engineer and furnish services as the Engineer may require for inspecting and obtaining data. These services shall include but not be limited to the measurement of lengths and dimensions of the various types of equipment used in construction operations.

2. Keep a set of records of each drilled shaft installed. Such records may include, but not limited to, the following data:

a. Dates and times of casing installation
b. Dates and times of drilling
c. Dates and times of reinforcement placement
d. Dates and times of concrete placement
e. Drilled shaft designation
f. Type and size of drilled shaft
g. Elevation of ground surface
h. Description of each soil and rock material encountered during excavation, and elevation of each change in stratum
i. Elevation of top of competent rock
j. Elevation of bottom of rock socket
k. Length of permanent casing, and top and bottom elevations of casing
l. Drilling tools used, and each change in tool during shaft excavation
m. Log of drilling operations and materials encountered
n. Composition and properties of drilling slurry
o. Concrete composition and testing results as required in Section 03301 for Self-Consolidating Concrete
p. Method of concrete placement
q. Volume of concrete placed, and plot of theoretical and actual concrete volumes versus elevation
r. Log of concrete placement operations
s. Results of integrity testing
t. Deviation of completed drilled shaft from specified location and alignment
u. Description of any operations to repair drilled shaft

3. Provide all necessary assistance to the Engineer so that the Engineer may keep a set of separate records of each drilled shaft installed.

4. In addition to all other inspection requirements for concrete as specified in this Section and in Specification Section 03301 titled "Portland Cement Concrete" as applicable to Self-Consolidating Concrete, the Engineer may direct that cores be obtained in accordance with procedures described in Item 1.04 herein to check on the quality of concrete placed.

5. Compare the computed theoretical volume of the excavation with the actual volume of concrete placed, and create a plot of depth versus volume. Submit results to the Engineer.

6. The Engineer may reject drilled shafts because of damage; failure to advance to required elevation; mislocation, misalignment, or failure to furnish and install the drilled shaft to the proper bearing stratum; or results of CSL testing and concrete coring indicating defects.

7. Within 10 days after completing the installation of all drilled shafts, and before removing the drilled shaft installation equipment from the Project Limits as shown on the Contract Drawings, submit to the Engineer a plan certified by a Land Surveyor registered in the states in which the Work was performed, showing the as-installed location of production and test drilled shafts and Demonstration Shafts. The Engineer will analyze the total loads on individual drilled shafts based on the survey data. If the load on any drilled shaft exceeds 10 percent of the specified load capacity,

correct the drilled shaft as directed by the Engineer. The corrections may include installation of additional drilled shafts.

8. Do not place substructure concrete on a drilled shaft until the concrete in the shaft reaches a minimum of 80 percent of the required 28-day compressive strength and until all CSL test results are approved by the Engineer and the CSL tubes have been dewatered and grouted and each drilled shaft within the same shaft group is accepted by the Engineer.

3.06 BORING AND SAMPLING

A. Before any shaft excavation, the Contractor shall perform an exploratory test boring at each demonstration and Load Test Shaft location where a boring does not exist, at the center of each pier column foundation, and at the center of each drilled shaft of the approach abutment foundations, or at locations otherwise directed by the Engineer. The test borings shall extend to a minimum of 20 continuous feet into competent rock. Competent rock shall be as defined in Section 3.02. If test cores do not meet the criteria of "Competent Rock" the test boring shall be extended to a maximum depth of 40 feet below the top of rock, which shall be determined by the Engineer.

B. The exploratory test borings shall be performed by an independent drilling firm with a minimum of 10 years drilling experience and approved by the Engineer. All borings shall be inspected and logged by a geologist or geotechnical engineer with a minimum of 5 years of boring and rock coring inspection and logging experience and approved by the Engineer. Notify the Engineer a minimum of 48 hours prior to the commencement of any exploratory test boring. The Engineer will be present during the exploratory test boring to observe the borings and sampling operations, and logging procedures. Provide necessary accommodation and assistance to the Engineer during his presence.

C. The test borings shall include both soil sampling starting at the ground surface and rock coring and shall consist of NX or NQ size triple tube split inner core barrel starting at the top of rock. Split spoon samples shall be obtained with Standard Penetration Tests at 5 foot intervals in soil and completely weathered rock deposits in accordance with ASTM D1586. Coring shall be performed in accordance with ASTM D2113. The test borings shall be cased from the ground surface to the final core run.

D. It is important that the percentage of recovery of the cores be as high as possible; the Contractor shall regulate the speed of the drill and remove the core frequently to maintain a maximum percentage of recovery, and special care shall be taken where the character of the rock being penetrated is uncertain.

E. Core shall be carefully removed from the core barrel, classified, and stored in well-constructed wooden core boxes with secure covers to prevent disturbance to the core during handling. The core samples will become the property of the Authority, and the Contractor will provide a spot on site for their storage until the Authority can take possession. The Contractor shall be responsible for delivering the core boxes and soil samples to a storage site identified by the Authority.

F. The Contractor shall exercise particular care in recording water losses, rod jerks, rod drops, changes in rotation speed and other unusual coring observations that will serve to supplement the core record and data regarding the nature and the extent of any fracturing, soft seams, voids and other characteristics of the formations being cored. The test boring

logs shall include rock description, rock quality designation (RQD), and rock recovery for each core run. Soil shall be classified in accordance with the requirements of ASTM D2487. The rock shall be logged in conformance with the recommendations and terminology presented in the ISRM, "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses".

G. RQD is a modified core recovery percentage in which the pieces of core over 4 inches long are summed and divided by the length of the core run. Note that only those pieces of rock that are classified as moderately weathered to unweathered shall be considered in the RQD count.

H. The result of the test borings shall be submitted to the Engineer for review before the start of any drilled shaft excavation. Field logs of the borings shall be submitted to the Engineer by 8:00 a.m. on the next working day after completing each boring; a typed log including color photos of all rock cores shall be submitted to the Engineer within five (5) working days after completing each boring.

I. Fill drill holes with cement grout by tremie method after completion.

J. Provide a minimum 48-hour advance notice to the Engineer before drilling of a boring starts. The Engineer may inspect the boring operation. Provide all necessary assistance as required for the Engineer's inspection.

3.07 UNACCEPTABLE DRILLED SHAFTS

A. Unacceptable drilled shafts are drilled shafts that are installed out of position, alignment, top or bottom elevation, damaged or not constructed in accordance with these specifications as indicated by the results of integrity testing, coring or other examination by the Engineer. The Engineer, at his discretion, may evaluate the magnitude of loads (lateral, axial and bending), that can be supported by the as-built drilled shaft. Should it be determined that the as-built drilled shaft is unacceptable, the Contractor shall repair the drilled shaft to the satisfaction of the Engineer or shall furnish and install a replacement or an additional drilled shaft or shafts as directed by the Engineer that will conform to the specified requirements at no additional cost to the Authority.

B. A shaft shall be rejected based on the shaft integrity testing and concrete coring unless conclusive evidence indicates that defects do not exist in the shaft which will result in inadequate or unsafe performance under service loads. If the CSL records are complex or inconclusive, upon request of the Engineer and at no cost to the Authority, perform additional testing to confirm the location of the defect.

C. For each rejected drilled shaft, submit to the Engineer for approval a plan showing how to correct the problem and prevent its reoccurrence. Repair, augment, or replace the rejected drilled shaft. If the Engineer rejects a drilled shaft, cease the construction of all other drilled shafts until the Contractor demonstrates the ability to construct an approved drilled shaft.

END OF SECTION

SECTION 02378

DRILLED SHAFTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalogue Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Proof of compliance with the experience requirements of 1.04 B, including the qualification of drilled shaft specialty contractor, the name and experience record of the drilled shaft superintendent in charge of drilled shaft operations and the geotechnical engineer in charge of the O-Cell testing

B. The Drilled Shaft Installation and O-Cell Testing Plan shall include a complete description of the proposed equipment and methods of drilled shaft excavation and support of excavation and O-Cell Testing, which includes:

1. Details of the overall anticipated construction operation sequence and the proposed sequence of shaft construction, including the proposed sequence between drilled shaft excavation, the shaft cap excavation and dewatering
2. Excavation support, decking, and dewatering methods, as required
3. Details of planned shaft excavation methods including removal of loose rock and sediment from the shaft bottom
4. Details and complete dimensions of all drill tools and drill rigs to be used
5. A discussion of suitability of the proposed equipment and procedures to the anticipated site and subsurface conditions
6. Details of the methods to be used to ensure shaft stability (i.e., prevention of caving, bottom heave, etc., using casing, slurry or other means) during excavation and concrete placement
7. Details the O-Cell load test set-up, loading procedures, instrumentation, O-Cell installation details and specifications, data collection and reporting system, and collection procedures
8. Casing dimensions and detailed procedures for casing installation
9. Plan and details of the Contractor's means and methods for obstruction removal
10. Plan for use of slurry, including design of slurry mix, de-sanding, testing the slurry, methods and equipment for handling and disposing of slurry, and the method of monitoring and continuously maintaining the slurry level
11. Details of concrete mix and ingredients as required for Self-Consolidating Concrete in Specification Section 03301 entitled "Portland Cement Concrete"
12. Shop drawings showing details of bracing of steel reinforcing cage, where shown, and design of spacing devices as required in 3.02 C; shop drawings or catalog cuts of all shoes and splices

13. Details of reinforcement lifting and placement including support and centralization methods
14. Details of methods to clean and maintain the shaft excavation, including removal of loose soil/rock fragments and sediment from the shaft bottom
15. The method used to fill or eliminate voids between the specified shaft diameter and excavated shaft diameter, or between the shaft casing and surrounding soil
16. Methods to determine drilled shaft dimensions and the deviation from vertical for the entire depth of the drilled shaft
17. Details of proposed methods to check shaft bottom cleanliness, including but not limited to proposed equipment, procedure, and log form for MiniSID inspection
18. Procedures for control, removal, and disposal of spoils
19. Details of equipment and methods for tremie placement or direct pumping of concrete into drilled shafts filled with water or slurry
20. Detailed procedures for withdrawing temporary casing, if used
21. The qualifications records of the testing organization to perform the CSL
22. Details of procedures, materials, and equipment for performing the CSL
23. Concrete core drilling equipment and procedures that may have to be used to retrieve the core specimens that may be required to determine the integrity of concrete placed in the drilled shaft

C. Certified mill test reports of all permanent drilled shaft pipe, reinforcing and steel cores.

D. Details of procedures, temporary sheeting/casing where needed to protect adjacent existing bridge foundations and other structure.

E. Record drawings showing the actual as-built location, alignment, elevation and dimensions of all drilled shafts

F. Details, and procedures including firm and staff experience for the exploratory test borings

G. Result of the exploratory test borings - field logs by 8:00 a.m. on the next working day after completing each boring, and typed log and color photos of all rock cores within five (5) working days after completing each boring

H. Field and final drilled shaft inspection records

I. Field data and final reports for all O-cell load tests

J. Records of all MiniSID inspection results

K. Records of all downhole camera inspection results

L. Records of all CSL test results

END OF APPENDIX "A"

DIVISION 2

SECTION 02445

PIPE BORING, JACKING AND ENCASEMENT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for furnishing and installing all materials and equipments and performing all labor required to install pipelines crossing under roadways or streets by boring and jacking as specified herein. Water carrier pipes within the casing pipe shall be restrained joint pipe of the type specified on the plans, or pre-approved by the Engineer. Contractor shall perform installation in accordance with the Contract Documents and as directed by the Engineer.

1.02 SYSTEM DESCRIPTION

A. A trenchless construction method to install a prefabricated jacking pipe through the ground from a drive shaft to a reception shaft, with the casing pipe propelled by jacks located in the drive shaft. The jacking force is transmitted through the pipe to the face of excavation. The excavation is accomplished, and the spoil is transported out of the jacking pipe and shaft manually or mechanically.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials(ASTM)
ASTM A134	Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded
ASTM A139/A139M	Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe
ASTM A36	Standard Specification for Structural Steel
	American Water Works Association (AWWA)
ANSI/AWWA C151/A21.51-09	AWWA Standard for Ductile-Iron Pipe
ANSI/AWWA C150/A21.50-08	AWWA Standard for Thickness Design of Ductile-Iron Pipe
	American Welding Society (AWS)
AWS D1.1	Structural Welding Code - Steel

1.04 QUALITY ASSURANCE

A. Installer Qualifications

1. Contractor or subcontractor performing the work described under this section shall demonstrate technical skill and experience in previous work of this nature. The Contractor shall submit a list of at least two pipe jacking projects successfully completed in the past five years. The Contractor shall submit descriptions of the pipe jacking projects completed in the last five years to serve as evidence of the capability to perform the work described in this section. The descriptions of the pipe jacking projects shall contain names and telephone numbers of owners' representatives who can verify the Contractor's participation on those projects. These descriptions shall be submitted with the boring procedure outlined in section 1.05E below, and will be evaluated by the Engineer. The Contractor shall also submit qualifications of key staff responsible for overseeing the jacking operations.

1.05 SUBMITTALS

A. Submit manufacturer's product data on encasement pipe.

B. Submit manufacturer's "Certificate of Compliance" to this part of the specifications for materials furnished for the project.

C. Casing spacer data sheets demonstrating compliance with this specification.

D. Plan showing the work zone equipment configuration at the ends of the jacking, staging areas, storage areas, cuttings and pit spoil-handling areas, and final placement areas.

E. Boring procedure, thrust block design, tooling for drilling, verification that size and type of casing can withstand installation stresses and method to verify that installed casing is acceptable. Include details on the cutting shield at the head of casing and type of soil conveyance system to be utilized (e.g. wheeled carts, belt conveyor, slurry system, auger system, vacuum extraction system).

F. Design of drive shaft and reception shaft, including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed Professional Engineer.

G. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.

H. Outline of work in accordance with Safety and Health Plan and a written confined space plan (addresses prevention of unauthorized entry, type of hazard, work practices, monitoring, provision for attendant, duties of employees, rescue and emergency medical services, multi-employer operations, and provisions for review procedures).

I. Casing Pipe Installation Records: Upon completion of the casing and carrier pipe installations, submit to the Engineer the installation As-Built drawings.

PART 2. PRODUCTS

2.01 MATERIALS

A. STEEL PIPE: Steel casing pipe shall conform to ASTM Specification A134, Mild Carbon Steel, A139, Grade A, or AWWA C200-91 Grade B, butt-welded joints with entire circumference welded by a certified welder shall be in accordance with AWWA C200-86 Section 3, Casing pipe thickness for Highway crossing shall be a minimum of ½ -inch thick regardless of diameters.

B. DUCTILE-IRON PIPE: Water carrier pipe shall conform to water main specifications.

C. CASING SPACERS: Stainless Steel casing spacers shall be required in all casing pipes and shall be manufactured by Pipeline Seal and Insulator Inc or approved equal. The casing spacers shall be affixed to the carrier pipe at a spacing of 6-ft.

D. END SEALS: End seals shall be 1/8" thick synthetic rubber secured with stainless steel banding straps or Link – Seal manufactured by Pipeline Seal and Insulator Inc or approved equal. Other end seals shall be constructed as pre-approved by the Engineer.

PART 3. EXECUTION

3.01 PREPARATION

A. Types, sizes, and number of jacks and other equipment used shall be as required for the proper installation of the pipe

B. Shore drive shaft to a reception shaft in accordance with the approved design.

C. Adequately protect any utilities located within the thrust block's zone of influence.

D. Survey the existing ground surface along the proposed path of casing installation prior to the start of work to set baseline data. Establish survey points in accordance with the approved design to determine presence/extent of ground movements

3.02 CASING PIPE INSTALLATION

A. The alignment of the casing shall conform to the following requirements:

1. Choose the ground entry and exit angles such that the casing can be installed along the alignment and profile indicated on the contract plans.
2. The entrance point(s) and exit point(s) shall be approved by the Engineer and physically located in the field by the Contractor.
3. The exit point shall be no more than ±1% of the bore length left or right of the location marked in the field.
4. The vertical depth, as specified in the contract documents, is the depth to which the casing shall be installed.

B. Direct all boring operations using steering and tracking systems capable of producing the required alignment within an allowable accuracy of ±1% of the bore length. Maintain the grade within 2 inches throughout the bore length. The steering control system shall provide an angle of inclination reading and the direction in which the cutting tool is pointing. Provide access to the Engineer at all times to all measuring or gauging devices used for the drilling operations, including drilling logs maintained by the Contractor.

C. Closely monitor the boring and jacking installation process to eliminate ground movements. If ground movements occur, stop work and immediately stabilize the area of concern. If it is determined during the installation process that the proposed lines and grades for the casing cannot be achieved, stop work. The Contractor shall then modify the methods of installation and submit them for review and approval of Engineer. Corrective stabilization actions are at the Contractor's expense.

D. In the event that the drill hole must be abandoned before completion of the installation or the installation is out of tolerance, fill the abandoned drill hole with Controlled Low Strength Material (CLSM) to prevent subsidence. Start pumping from the farthest point of progression of the abandoned drill hole back to the surface to eliminate encapsulating voids. The progression and restoration of the abandoned drill hole by CLSM placement will be at the Contractor's expense. The location of the new drill hole shall be approved by Engineer prior to progression of the operation.

E. Grout voids/ annular space between the casing and excavated boring in accordance with the methods approved by Engineer.

3.03 CARRIER PIPE INSTALLATION

A. Carrier pipe may be pushed or pulled through the completed casing pipe. Casing spacers by Pipeline Seal and Insulator Inc or pre-approved equivalent should be placed on the carrier pipe to insure carrier pipe centered and restrained within the casing pipe and to prevent damage during installation. Care must be exercised in order to avoid metal-to-metal contact. The ends of the casing pipe shall be sealed with end seals and stainless steel bands.

B. Water carrier pipe installed within a casing shall be restrained and shall be poly-wrapped.

3.04 SAFETY

A. For entry into casing by personnel:

1. Provide confined space training prior to entry, when there is a change in operations, or when deviation in policy occurs.

2. Entry Supervisor shall verify the requirements of the Entry Permit, ensure means of rescue are readily available, cancels or terminates entry as required, removes unauthorized personnel, and periodically monitors the Pipe Jacking operation for conformance.

3. Attendant shall maintain accurate account of authorized entrants, remains at entry site until relieved by another attendant or until work is complete, monitors conditions around space and maintains communication with entrant(s), and performs non-entry rescue or summons rescue and medical services, as needed.

4. Entrant(s) shall properly use required equipment, maintain communication with Attendant, and evacuate if emergency occurs.

5. Confined spaces shall be monitored for oxygen, carbon monoxide, and explosive gases before and during entry. When organic material is present, hydrogen sulfide levels will be tested. Testing shall be conducted from top down as space allows at various levels. Test results shall be recorded on the permit. Entry shall not be made or the space shall be vacated when:

   a. Oxygen levels are less than 19% or greater than 23%; or

   b. Explosive gases are greater than 10% of lower explosion limit; or

   c. Toxic gases greater than permissible exposure limits; or

   d. Carbon Monoxide levels are greater than 35 ppm; or

   e. Hydrogen Sulfide levels are greater than 10 ppm.

END OF SECTION

SECTION 02445

PIPE BORING, JACKING AND ENCASEMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Construction and Installation Procedures

02445G01 Specifies requirements to install pipelines crossing under roadways by boring and jacking

END OF APPENDIX "A"

DIVISION 2

SECTION 02485

MECHANICALLY STABILIZED EARTH (MSE) WALLS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the design and construction of permanent and temporary mechanically stabilized earth (MSE) retaining walls. Wire mesh facing shall be used for temporary MSE wall systems. The temporary MSE walls consist of constructing the embankment fill with a welded wire and fabric facing and reinforcing strips.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO	LRFD Bridge Design Specifications, 6th Edition, 2012
AASHTO	LRFD Bridge Construction Specifications with Interims
AASHTO M288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO T27	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHTO T90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T99	Standard Method of Test for Moisture-Density Relations of Soils using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T104	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T234-85	Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression
AASHTO T236	Standard Method of Test for Direct Shear Test of Soils under Consolidated Drained Conditions
AASHTO T267	Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
AASHTO T288	Standard Method of Test for Determining Minimum Laboratory Soil Resistivity
AASHTO T289	Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing
AASHTO T290	Standard Method of Test for Determining Water-Soluble Sulfate Ion Content in Soil
AASHTO T291	Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil
AASHTO T310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

American Society for Testing and Materials (ASTM International)

ASTM	*Standard Specification for:*
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM	*Standard Test Method for:*
ASTM D792	Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1238	Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1603	Carbon Black Content in Olefin Plastics
ASTM D4327	Anions in Water by Chemically Suppressed Chromatography
ASTM G187	Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method

Federal Highway Administration (FHWA)

FHWA NHI-07-092	Geosynthetic Design and Construction Guidelines, Holtz, R.D. et al., 2008
FHWA NHI-00-044,	Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Victor Elias, 2000

New Jersey Interagency Engineering Committee (NJIEC)

NJIEC	Standard Soil Aggregate Gradations

1.03 Related Sections

Section 02145 – Dewatering

Section 02212 – GEOTECHNICAL INSTRUMENTATION AND MONITORING

Section 02221 – EXCAVATION, BACKFILLING AND FILLING

Section 02260 – Special Excavation Requirements

Section 02892 – HANDLING, treatment AND DISPOSAL OF SOIL MATERIALS (NEW JERSEY)

Section 02894 – HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL MATERIALS (NEW YORK)

Section 02895 –Disposal of Hazardous Material

Section 02897 – Contaminated Materials Management

1.04 QUALITY ASSURANCE

1. Construction Standards: Design and construction of MSE walls shall be in accordance with AASHTO LRFD Bridge Design Specifications, 6th Edition (2012), and with the current edition of AASHTO LRFD Bridge Construction Specifications with Interims, with modifications herein.
2. MSE walls shall be designed for a minimum 75-year design life. MSE walls which support embankments under bridge abutments shall be designed for a 100-year design life.
3. The entity performing the Work of this section shall be a contractor experienced in MSE wall construction with suitable equipment and competent personnel. The Contractor shall submit a list of at least 5 MSE wall projects successfully completed in the past five years. The five projects shall contain not less than three contracts with soil conditions and wall heights similar to those contained in this project. The Contractor shall submit descriptions of the MSE wall projects completed in the last five years to serve as evidence of the capability to construct MSE walls. The

descriptions of the MSE wall projects shall contain names and telephone numbers of owners' representatives who can verify the Contractor's participation on those projects. These descriptions shall be submitted within 90 calendar days of Notice to Proceed. The Contractor shall also submit qualifications of key staff responsible for overseeing MSE wall installation.

4. The Design Calculations shall be signed and sealed by a Professional Engineer licensed in the States of New Jersey and New York. The Professional Engineer shall have at least 10 years of experience in the design of MSE wall systems. The Contractor shall submit the Professional Engineer's resume, which shall clearly indicate the requisite years of experience and include project name, client, location, design start and end dates, and details regarding MSE wall design for each project.

5. All equipment shall be maintained in a satisfactory working condition and shall be operated by competent and experienced personnel throughout the operation.

6. Conduct layout work for each MSE wall to lines and levels required and submit final measurements of front wall face location, as-built gutter line elevations, bottom of leveling pad elevations, finished ground line elevations, deviations from specified tolerances, and other data as required.

7. Instrumentation

   a. Four settlement plates shall be furnished and installed prior to the addition of fill at MSE Wall No. 3 location as shown on the Contract Drawings. Settlement plates shall be furnished and installed in accordance with Section 02212 of these Specifications.

1.05 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions:

1. The Contractor shall notify the Engineer with a minimum seven-day notice before proceeding with the Work.

2. The Contractor shall protect all adjacent structures and utilities from damage due to the Work. Prior to the start of installation activities, the Contractor shall locate and pre-excavate to expose portions of the existing utilities within the MSE wall installation area, and furnish and install support and protection as necessary such as not to adversely affect the integrity of the utilities due to construction activities. The excavation and support methods shall be approved by the Engineer.

3. Should uncharted or incorrectly charted structures or utilities be encountered, the Engineer shall be immediately notified and consulted for directions as to procedure. The Contractor shall coordinate with the Authority, and public and private utility companies in keeping their respective services and facilities in operation. Damaged structures and utilities shall be repaired or replaced to the satisfaction of the Engineer, and structure owner or utility owner at no expense to the Authority.

B. Alignment and Tolerances

1. Precast Panel Unit Production Tolerances

   a. All precast panel units shall be manufactured within the following tolerances:

      (1) All dimensions within 3/16 inch

      (2) Deviation from vertical or horizontal no more than 1/8 inch per 5 feet

   b. Precast panel units shall be rejected because of failure to meet any of the requirements specified above. In addition, any or all of the following defects as assessed by the Engineer shall be sufficient cause for rejection:

(1) Defects that indicate imperfect molding

(2) Defects indicating honeycombed or open texture concrete

(3) Defects in the physical characteristics of the concrete units, such as:

(a.) Stained front face due to excess form oil or other reasons

(b.) Signs of aggregate segregation

(c.) Broken or cracked corners or edges

(d.) Tie strips bent or damaged

(e.) Lifting inserts not usable

(f.) Exposed reinforcing steel

(g.) Cracks at the PVC pipe or pin

(h.) Insufficient concrete compressive strength

(i.) Panel thickness in excess of 3/16 inch from that shown on the Contract Drawings

(j.) Deviation from flatness of exposed surface in excess of 1/8 inch per 5 feet

c. An additional inspection shall be made prior to erection to determine any damage which may have occurred during transportation and storage.

d. The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer at no additional cost to the Authority.

e. Repair to concrete surfaces which will be exposed to view after completion of construction shall be subject to review and approval of the Engineer.

2. Wall Construction Tolerances

a. Finished MSE walls shall be erected within the following tolerances:

(1) The overall vertical alignment tolerances, or plumbness, from top to bottom of the structure, shall not exceed 1/2 inch per 10 feet of wall height.

(2) Deviation from horizontal alignment shall not exceed 3/4 inch.

(3) Vertical and horizontal alignment tolerance, or plumbness, shall not exceed 3/4 inch when measured with a 10-foot straight edge on a selected wall section.

(4) The maximum allowable offset between any two panels shall not exceed 3/4 inch.

1.06 SUBMITTALS

A. See Appendix A for Submittal Requirements.

B. Review of MSE Wall Working Drawings

1. The Engineer will evaluate the MSE wall working drawings for conformance with the Contract Drawings and these Specifications.

2. Within 30 calendar days after receipt of the working drawings, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary in the opinion of the Engineer to satisfy the Contract Drawings and these Specifications.

3. Any part of the working drawings that is unacceptable will be rejected and the Contractor shall submit the drawings with required changes for reevaluation. The Engineer will notify the Contractor in writing within 10 working days after receipt of proposed changes of their acceptance or rejection. Approvals given by the Engineer will be subject to trial and satisfactory performance in the field.

4. MSE wall installation shall not begin until the MSE wall working drawings have been approved by the Engineer. Approval of the MSE wall working drawings will not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed on the Contract Drawings and in these Specifications.

1.07 DEFINITIONS

1. "Mechanically Stabilized Earth (MSE) Wall": unless otherwise noted on the Contract Drawings, MSE wall is defined as the wall system that includes the facing elements, select backfill, soil reinforcement elements and their connections with the facing and all components, elements, or appurtenances, such as copings, parapets, barriers, moment slabs, wall underdrains and geomembrane, etc., founded on or located within the select backfill or attached to any component of the wall system within the select backfill.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Materials shall conform to the current editions of AASHTO LRFD Bridge Design Specifications with Interims and AASHTO LRFD Bridge Construction Specifications with Interims, unless otherwise specified herein and the provisions of the wall system selected for construction in this Contract.

B. Bearing Pads

1. Bearing pads shall conform to the requirements of the wall manufacturer.

C. GEOTEXTILE (Filter Fabric)

1. Geotextiles shall conform to AASHTO M288 for subsurface drainage geotextiles.

D. Soil Reinforcement elements

1. Use of extensible soil reinforcement elements for MSE walls will not be permitted.
2. The wall system supplier shall make recommendations regarding the corrosion rates that shall provide the required 75- to 100-year service life.
3. The determination of corrosion rates shall be based on data presented in the FHWA NHI-00-044 (Elias, 2000).
4. Welded wire mesh for the temporary wall facing shall conform to ASTM A185. The minimum size welded wire shall conform to ASTM A82.

E. MSE Wall Systems

1. The following MSE Wall Systems are permissible for use in this Contract:

a. **Sine Wall MSE Panel System as manufactured by**
Sine Wall, LLC
7162 Liberty Centre Drive, Suite 105

West Chester, Ohio 45069
www.sinewall.com
513-759-2345 Office
513-297-7930 Fax

b. **Reinforced Earth as manufactured by**
Reinforced Earth Company
8614 Westwood Center Drive, Suite 1100
Vienna, VA 22182-2233
Telephone Number: 703-749-9246

c. **SSL MSE Plus Retaining Wall System as manufactured by**
SSL
4740 Scotts Valley Drive, Suite E
Scotts Valley, CA 95066
Telephone Number: 831-430-9300
Fax Number: 831-430-9340

d. **Isogrid Retaining Wall System as manufactured by**
The Neel Company
8328-D Traford Lane
Springfield, VA 22152
Telephone Number: 703-913-7858

e. **Tricon Retained Soil Wall System as manufactured by**
Tricon Precast, Ltd.
Main Office
15505 Henry Rd.
Houston, Tx 77060
Info@Triconprecast.Com
281-931-9832 Office
281-931-0061 Fax
877-387-4266 Toll Free

f. **Earth Tec Retaining Wall System**
EarthTec, Inc.
413 Browning Court
Purcellville, VA 20132
703-771-7305 (tel)
703-771-7306 (fax)

2. Selection of only one MSE wall system will be permitted for use on this Contract. The Contractor shall make its own arrangements to purchase the materials and services from one of the manufacturers of a permissible MSE Wall System listed herein.

F. Select Backfill Material

1. Select backfill conforming to the requirements herein shall be used within the limits shown on the Contract Drawings and shall be procured from off-site sources. On-site excavated material shall not be used for backfilling and filling MSE walls.

2. Select backfill used in the MSE wall system shall be reasonably free from deleterious materials, shale, or poor durability particles and shall conform to the following gradation limits as determined by AASHTO T27:

Sieve Size	Percent Passing
4 inches	100
¾ inch	30-100
No. 4	5-85
No. 40	0-60
No. 200	0-10

3. Material that is composed primarily of gravel (material having less than 40 percent passing a 3/4-inch sieve) shall be considered to be a coarse backfill. When such material is used, a Class 1 high survivability geotextile filter, in accordance with AASHTO M288 designed for filtration performance following the guidelines in FHWA NHI-07-092 (Holtz et al., 2008), shall encapsulate the coarse backfill to within 3 feet below the wall coping. Adjoining sections of separation geotextile shall be overlapped by a minimum of 12 inches. Additionally, the upper 3 feet of backfill shall contain no stones greater than 3 inches in their greatest dimension and shall be composed of material not considered to be gravel backfill, as defined herein.
4. Recycled concrete will not be permitted to be used as select backfill material.
5. Select backfill shall meet the following electrochemical limits:

Property	Standard	Test Procedure
Resistivity, Ω - cm	Greater than 3,000 at 100% saturation	AASHTO T288
pH	Acceptable Range of 5 - 10	AASHTO T289
Organic Content	1.00% Maximum	AASHTO T267
Chloride	Less than 100 ppm	AASHTO T291 or ASTM D4327
Sulfates	Less than 200 ppm	AASHTO T290 or ASTM D4327
Magnesium Sulfate Loss	Less than 30% after 4 Cycles	AASHTO T104
Sodium Sulfate Loss	Less than 15% after 5 Cycles	AASHTO T104

6. Prior to any construction, the Contractor shall take the specified number of test samples from all proposed select backfill material sources and submit the results to the Engineer for review and approval. For the design of the wall including soil reinforcement elements, the wall system supplier shall use the friction angle determined from test results, an appropriate unit weight, and the electrochemical limits for select backfill specified herein.
7. No materials shall be delivered to the site until approved by the Engineer.
8. Test sampling and testing for gradation, plasticity and density shall be performed throughout the course of the MSE wall construction (during construction) as materials are delivered to the site. Except as noted below, sample tests that fail to meet the specified requirements may be repeated at the Contractor's option. Repeated sample tests shall be averaged with the failing sample test to determine the

final tested soil properties. A maximum of two repeated sample tests will be permitted.

9. The frequency of sampling and testing shall be performed as described below for all limits noted in Section 2.01.F.5. A minimum of two samples per structure shall be taken. Additional samples shall be taken whenever appearance or behavior of the select backfill changes and as directed by the Engineer. Select backfill test sampling frequency shall be as follows:

Range of Resistivity (Ω-cm)	General Description	Pre-construction	During Construction	Comments
		No. Samples	Sample Interval (yd^3)	
>10,000	Crushed rock and Gravel <10% passing No. 10 sieve	1/3[1]	4000 / 2000[1]	A. pH outside the specified limits is not allowed for any sample. B. Backfill sources shall be rejected if resistivity measured for any one sample is less than 700 Ω-cm, chloride content > 500 ppm or sulfate content > 1000 ppm. C. For materials with resistivity <5000 Ω-cm, Chloride and Sulfate testing requirements shall apply.
5,000 to 10,000	Sandy Gravel and Sands	3/6[1]	4000 / 2000[1]	
<5,000	Silty sands and Clayey sands screenings	5/10[1]	2000 / 1000[1]	
[1] # resistivity tests / # tests for pH, Cl , and SO_4				

10. If resistivity is greater than or equal to 5,000 ohm-cm, the chloride and sulfates requirements may be waived at the discretion of the Engineer.

11. The angle of internal friction for the select backfill, as determined by the direct shear test in accordance with AASHTO T236 or the tri-axial compression test in accordance with AASHTO T234-85, shall not be less than 34 degrees.

12. Where greater than 75% of the particles of the select backfill are retained on the 3/4-inch sieve, the direct shear and tri-axial compression test requirements may be waived in lieu of an assumed 34-degree soil angle of internal friction.

13. The Plasticity Index (PI) of the select backfill, as determined by AASHTO T90, shall not exceed 6.

14. AASHTO T267 shall report the organic content as a percent by weight of the total soil fraction and not only what is passing the number 10 sieve. Organic content of select backfill shall be limited to 1 percent by weight of the total soil fraction.

15. ASTM G187 may be substituted for AASHTO T288 in instances where insufficient material passing the number 10 sieve is present. This test shall be completed on materials passing the number 4 sieve with an appropriately sized resistivity box utilized.

16. The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the select backfill complies with this Subsection prior to the installation of the wall.

17. A copy of all test results performed by the Contractor's Testing Agency which are necessary to ensure compliance with these Specifications shall also be furnished prior to delivery and placement of the select backfill.

G. High Density Polyethylene (HDPE) GEOMEMBRANE

1. HDPE geomembrane shall have a nominal thickness of 30 mils.

2. The geomembrane shall be manufactured of new, first quality resin and shall be compounded and manufactured specifically for the intended purpose.

3. The resin manufacturer shall certify each batch for the following properties:

Property	**Test Method**	**Requirements**
Specific Gravity	ASTM D792	> 0.940
Melt Index	ASTM D1238	< 0.4g/10 min.
Carbon Black Content	ASTM D1603	2% - 3%

The HDPE supplier shall submit this certification for the Engineer's verification of the material.

4. The surface of the HDPE geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, and any foreign matter, such as soil or oil accumulation.

PART 3. EXECUTION

3.01 GENERAL

1. It shall be Contractor's responsibility to design and construct MSE wall structures composed of precast concrete facing panels, cast-in-place and/or precast parapets, moment slabs, copings, concrete leveling pads, soil reinforcement elements, joint materials, fasteners, select backfill, and all other appurtenant items of construction within the common structure volume as shown on the Contract Drawings, included as part of the selected MSE Wall System, and as specified herein.

2. Design and construction of MSE walls shall be in accordance with the current AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications, unless otherwise specified herein.

3. All labor, materials, equipment, and tools as required to prepare the site, construct the leveling pad, construct the wall, place and compact select backfill, and construct the coping and traffic barrier shall be supplied by the Contractor.

4. Where an MSE wall is constructed supporting a roadway that will be subjected to chemical deicing, installation of a High Density Polyethylene (HDPE) geomembrane, as shown on the Contract Drawings and specified in Article 2.01.G, shall be included. All labor, materials, transportation, handling, storage, supervision, tools, and other equipment that may be necessary to install and test the HDPE geomembrane shall be included.

3.02 INSTALLATION

A. MSE WALL CONSTRUCTION

1. Methods of construction shall conform to the current editions of AASHTO LRFD Bridge Design Specifications with Interims and AASHTO LRFD Bridge Construction Specifications with Interims, unless otherwise specified herein, and the provisions of the permitted wall system selected for construction in this Contract.
2. An on-site technical representative from the selected MSE Wall System manufacturer shall be present to assist and instruct during the installation of the first two-panel courses of the first wall location, as a minimum.
3. The front face vertical and horizontal joints between precast panels shall have 1-foot-wide strips of geotextile (filter fabric) behind each joint starting 2 feet below grade.
4. Soil reinforcement elements shall be uniformly tensioned to remove any slack in the material or in the connections to the facing panels.
5. The foundation for the structure shall be graded level for a width exceeding the length of reinforcement for a minimum of 24 inches. Prior to wall construction, the foundation bed, if not in rock, shall be compacted with a smooth wheel vibratory roller. Any foundation soils found to be unsuitable shall be removed and replaced within the limits and to the depth ordered by the Engineer with a material which shall conform to the requirements for NJIEC I-12 designation compacted in accordance with Section 02221.
6. The compacted density of the select backfill shall be determined by taking one test series for each half height of wall panel of elevation, to a maximum of 3 feet, placed in accordance with AASHTO T310 Method B. Select backfill shall be compacted to a minimum of 95% maximum density as determined by AASHTO T99, Method C, or greater if specified by the MSE wall system manufacturer. Optimum select backfill moisture content to achieve minimum required compacted soil density shall be as determined by AASHTO T99.
7. The specified compaction of the select backfill shall be accomplished by use of large, smooth drum, vibratory rollers with the exception of the 5-foot zone directly behind the facing panels. Use of sheeps-foot roller will not be permitted.
8. Within the 5-foot zone, small, single- or double-drum, hand-operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors shall be used, and at least three passes shall be made.
9. When there is evidence of wall displacement or disturbance, compaction shall be accomplished by use of a smooth-drum static roller.
10. The compaction equipment shall be capable of providing uniform density throughout the depth of the layer of the select backfill being compacted with no disturbance to the vertical or horizontal alignments of the previously placed panels.
11. At MSE Wall No. 3, where settlement is expected, placement of the pavement shall not begin until a waiting period of 90 days, or a duration directed by the Engineer, to allow the settlement process to be observed. The Engineer will evaluate actual settlement based on field instrumentation data to determine the settlement (consolidation) period. The Engineer will be the sole judge to determine that the settlement has been completed. Construct the pavement upon written authorization from the Engineer.

12. Ensure that the wall coping system will accommodate the full-range of settlement, ranging from zero to 6 inches, differential settlement between stages, and anticipated long-term settlement, without requiring cutting of the precast panels or units.

B. High Density Polyethylene (HDPE) GEOMEMBRANE Construction

1. Before geomembrane installation, it shall be assured that the area to be lined shall be smooth and free of sharp objects or debris of any kind.
2. Atmospheric exposure of geomembrane to the elements following lay down shall be a maximum of 14 days.
3. The Contractor shall furnish and install HDPE geomembrane free of holes and tears.
4. The HDPE shall be placed below the pavement, above the top row of reinforcements, over the parapet moment slab (where present), and over specified areas shown on the Contract Drawings.
5. The HDPE geomembrane shall be sloped to drain away from the facing panels.
6. HDPE shall not be installed during periods of precipitation or in conditions of excessive moisture such as fog or dew.
7. All seams of the HDPE geomembrane shall be as per the manufacturer's specifications, sealed or overlapped to prevent leakage. Seams shall be oriented parallel to the line of maximum slope. Seams shall have a minimum finished overlap of 4 inches unless a greater overlap is specified by the HDPE manufacturer.
8. Field testing of seams shall be performed in accordance with the manufacturer's specifications to verify satisfactory seaming conditions.
9. When backfilling, care shall be taken to prevent damage to the HDPE system. Any tears, punctures, or holes incurred during the installation process shall be assessed by the Engineer, and the membrane shall either be repaired in accordance with recommendations of the membrane manufacturer or replaced at the Engineer's discretion at no additional cost to the Authority.
10. Perforations through the liner shall be limited. Where penetrations are necessary, the Contractor shall submit details demonstrating the method(s) of sealing the penetration for approval by the Engineer.

C. Construction Stormwater Management

1. At the end of each construction period, the Contractor shall slope the last placed level of backfill away from the wall facing to direct runoff or rainwater away from the wall face.
2. Surface runoff shall not be allowed to enter the wall construction site from adjacent areas.

END OF SECTION

SECTION 02485

MECHANICALLY STABILIZED EARTH (MSE) WALLS

SUBMITTALS

APPENDIX A

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

a. Design calculations, signed and sealed by a Professional Engineer licensed in the States of New York and New Jersey, in conformance with the current edition of AASHTO LRFD Bridge Design and Constructions Specifications with Interims and modifications herein and the provisions of the approved wall system selected for construction in this Contract.

b. General notes, design parameters, soil characteristics of select backfill, and factors of safety and/or load and resistance factors.

c. An elevation view of the wall showing:

(1) Elevations along the top of the wall, at beginning and end of the wall, at 25-foot intervals, at changes in grade, at changes in the select backfill limits, and at precast panel unit joints where indicative of wall geometry.

(2) Elevations and step locations for leveling pads and/or footings.

(3) The location of the final ground line.

(4) Number and type of precast panel units

(5) A numbered panel layout for fabrication and erection purposes.

(6) Designation of breaks in vertical alignments and elevations.

(7) Locations and elevations/inverts of any utilities or drainage which passes through the retaining wall or the select backfill.

d. A plan view of the wall showing:

(1) The offset from the construction baseline to the face of precast wall elements at all changes in horizontal alignment.

(2) Right of way (ROW) limits and their relationship to the wall with offsets and stations to wall corners and ends.

(3) Locations of piles, drilled shafts, noise walls, sign structures, or other appurtenant items which are supported by the wall or its parapet/coping.

(4) Locations and alignments of any utilities or drainage which passes through the retaining wall or the select backfill.

(5) The offset from the construction baseline to limits of MSE wall at all changes in horizontal alignment and offsets of MSE wall limits.

e. Typical sections of walls showing:

(1) Limits of cut and fill work.

(2) Limits of select backfill, retained backfill behind the select backfill, and drainage materials.

(3) Limits of MSE wall and associated appurtenant items such as drainage features, impervious geomembrane, and soil reinforcement elements.

(4) Location of final ground lines.

(5) Type, dimensions and spacing of reinforcement elements.

(6) Details of connections of reinforcement to wall panels.

f. Precast panel unit details for all panel types, including non-standard panels, with all dimensions necessary to construct the panels with locations in the member of all appurtenant items such as reinforcement steel, soil reinforcement element attachment points, and lifting devices.

g. Details for footings, leveling pads, and footing or leveling pad step details, where required.

h. Details for precast barriers, copings, and connections to all appurtenant items such as railings, fences, lighting standards, and noise barriers.

i. Details for wall construction and soil reinforcement element placement to accommodate any obstructions such as piles, drilled shafts, utilities, acute corners, slip joints, highway lighting systems, drainage structures, and any other obstructions.

j. Details for any cast-in-place elements with all dimensions necessary to construct the elements with locations in the member of all appurtenant items such as reinforcement steel.

k. Detail for any architectural treatments such as facing finish, texture, and color.

l. The manufacturer's installation manual including sequence of construction. Two bound copies of the approved manual shall be furnished to the Engineer.

m. Manufacturer's data on material for impervious geomembrane, and for placement of the impervious geomembrane, including construction and testing of seams.

END OF APPENDIX "A"

DIVISION 2

SECTION 02510

PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for placement of Portland cement concrete pavement and bonded or unbonded Portland cement concrete overlays of existing pavement. For requirements for furnishing Portland cement concrete see Section 03301 entitled "Portland Cement Concrete, Long Form".

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway Transportation Officials (AASHTO)

AASHTO M 254	Corrosion Resistant Coated Dowel Bars.

American Society for Testing and Materials International (ASTM)

ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM D 1751	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
ASTM D 4397	Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
ASTM E 950	Measuring the longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
ASTM E 1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

American Concrete Institute (ACI)

ACI 309	Guide for Consolidation of Concrete.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging conditions appear imminent. Have on hand at the construction site at all times when placing concrete sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Completely remove and replace at no cost to the Authority any pavement damaged by rain or other weather conditions.

B. Cold Weather Conditions

1. Cold weather concreting shall conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".
2. Ensure that reinforcement, forms and ground with which concrete will be in contact are completely frost free. The use of chemicals to eliminate frost will not be permitted.
3. Comply with all provisions herein for placing and curing.

C. Hot Weather Conditions

Hot weather concreting shall conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

1.04 IN-PLACE PAVEMENT AND OVERLAY REQUIREMENTS

A. Concrete shall conform to the thicknesses shown on the Contract Drawings. Acceptance will be on a lot basis as set forth in Section 03301 entitled "Portland Cement Concrete, Long Form". Test for thickness only after all corrections for smoothness and grade have been completed.

B. Pavement Alignment

Lateral deviation from the alignment of the pavement edge shown on the Contract Drawings shall not exceed plus or minus 0.10 foot.

C. Final Surface Grade

The final surface shall conform to the finished grades shown on the Contract Drawings within a target tolerance for vertical deviation of plus or minus 0.04 foot, except where closer tolerance is required for proper functioning of appurtenant structures and drainage. The final surface abutting existing pavements shall smoothly transition to the existing surface grades. The Engineer will test the final surface, which will be accepted or rejected on a lot basis as set forth in 3.03 B. For roadways, the Engineer will adjust Contract compensation based on the percentage of grade measurements exceeding the target tolerance as set forth in 4.02 A. Make corrections for deficiencies as set forth in 3.05 B and D.

1. Roadway and bridge deck Pavements

a. Surface smoothness deviations shall not exceed 1/8 inch in 10 feet in both the longitudinal and transverse directions when tested with a 10-ft straight edge. In addition, the final surface shall have a Profile Index of 15.0 inches per mile or less and no deviations shall be greater than 0.4 inch in 25 feet. Testing and acceptance will be on a lot basis as set forth in 3.03 A.1. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.02 B. Make corrections for deficiencies in surface smoothness as set forth in 3.05 A and D.

D. Check dowel bars and assemblies for position and alignment. The maximum permissible tolerance for dowel bar alignment in each plane, horizontal and vertical, shall be 2 percent or 1/4 inch per foot of dowel bar. Dowel position shall meet the following:

1. Horizontally, within plus or minus 1/2 inch of specified spacing.
2. Vertically, within plus or minus 1/2 inch at mid-depth of slab.
3. Midpoint of the dowel relative to the center of the joint, within one inch.

E. For slipformed concrete not more than 15 percent of the total free edge of each five hundred feet of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch, and none of the free edges of the pavement shall have an edge slump exceeding 3/8 inch. The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches from the edge. Make corrections for deficiencies made as set forth in 3.05 C.1.f.

1.05 QUALITY ASSURANCE

A. Develop a Quality Control Program in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form". In addition to the requirements therein, the program shall address all elements which affect the quality of the pavement including but not limited to:

1. Placing and consolidation.
2. Joints.
3. Dowel placement and alignment.
4. Finishing and curing.
5. Surface smoothness.
6. Alignment and grade.
7. Thickness.
8. Surface preparation for unbonded overlays.
9. Surface preparation for bonded overlays.

B. Surface Smoothness

Perform quality control smoothness testing of the final surface using methods which produce results with measuring units and accuracy similar to the Engineer's acceptance testing specified in 3.03 A. As a minimum test the final surface of each day's paving after initial curing is completed. Submit written results to the Engineer after each test. Test results shall clearly identify the test location. Upon completion of all quality control testing and any required corrective work, the Engineer will perform acceptance testing in accordance with 3.03 A.

C. Final Surface Grade Side-Form Construction

Perform quality control surveys of forms to check grades. Measure elevations at the finished grade locations shown on the Contract Drawings. Submit to the Engineer written survey results prior to scheduling concrete placement. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01 foot, required finished grades from the Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control. Acceptance of the finished surface will be as specified in 3.03 B.

D. Final Surface Grade Slipform Construction

Perform quality control surveys to check grades immediately after initial curing is completed. Measure elevations at the finished grade locations shown on the Contract Drawings. Submit the written survey results to the Engineer. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01 foot, required finished grades from the Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control. Acceptance of the finished surface will be as specified in 3.03 B.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Portland Cement Concrete

Conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

B. Forms

1. Straight side forms shall be made of steel having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete without horizontal joint, and a base width equal to the depth of the forms.

2. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer.

3. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

4. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the construction site. Repaired forms shall not be used until inspected and approved by the Engineer.

5. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall vary from a true plane by not more than 1/8 inch in 10 feet, and the upstanding leg shall vary by not more than 1/4 inch. The forms shall have provisions for locking the ends of abutting sections together tightly for secure setting.

6. Forms shall have a top flange approximately two inches wide.

7. Forms may be punched to admit dowels.

C. Joints

1. Preformed bituminous joint filler shall conform to ASTM D 1751 and shall be punched to admit dowels. Filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

2. Dowels shall be straight, smooth, solid round bars, free from burring or other deformation that would interfere with free movement in the concrete. They shall be resistant to abrasion resulting from pavement expansion and contraction and shall be one of the following:

   a. Carbon steel (ASTM A 615, Grade 60) tightly encased in stainless steel tubing or infused with chromium over the entire exposed surface.

   b. Organic coated steel dowel bars (ASTM A 615, Grade 60) conforming to AASHTO M 254.

3. Joint support assemblies shall be capable of maintaining dowels and joint filler where required, in proper position and alignment both before and during concrete placement.

4. For expansion joints, furnish and install metal or plastic sleeve-type end caps for dowel bars. End caps shall cover four inches of the dowel, with a closed end containing a compressible plug to hold the end of the sleeve at least one inch from the end of the dowel bar.

5. Shop applied bond breaker, if used, shall meet the pullout requirements for AASHTO M 254.

6. Tie bars (ASTM A 615, Grade 40) shall conform to Section 03200 entitled "Concrete Reinforcement".

D. Cement Paste

A uniform mixture of cement, fine aggregate and water with the consistency of a paste, broomed out of the concrete as it is placed. A separately mixed paste will not be permitted.

E. Grout

1. Epcon A7, manufactured by ITW Ramset/Red Head, Wood Dale, IL.
2. Epcon Ceramic 6, manufactured by ITW Ramset/Red Head, Wood Dale, IL.
3. HIT HY-150, manufactured by Hilti Fastening Systems, Tulsa, OK.
4. Keligrout, manufactured by Kelken Construction Systems, Parlin, NJ.
5. Power-Fast Cartridge, manufactured by Power Fastening, Inc., New Rochelle, NY.
6. Sure Anchor I (J-51), manufactured by Dayton Superior, Oregon, IL.
7. An approved equal, as accepted by the State of New Jersey Department of Transportation and New York State Department of Transportation, which is chemically cured.

F. Welded Wire Fabric shall conform to Section 03200 entitled "Concrete Reinforcement".

G. Polyethylene Film: ASTM D 4397, two-ply.

PART 3. EXECUTION

3.01 PREPARATION

A. Surface Preparation

1. Full-Depth Pavement

a. Side-Form Construction

(1) After completion of the fine grading of the base course, lay and anchor forms to lines and grades shown on the Contract Drawings. The base course shall be prepared at least one foot beyond the edge of all forms and shall be in firm contact with the forms for their entire length. After the forms have been set to the correct grade, thoroughly tamp the base course, either mechanically or by hand, at both the inside and outside edges of the base of the forms when the forms are not placed on a previously paved surface.

(2) Ruts or depressions in the subgrade or subbase caused by hauling or usage of other equipment shall be filled with suitable material (not with concrete or concrete aggregates) as they develop and shall be thoroughly compacted by rolling. If damage occurs to a stabilized subbase, it shall be corrected full depth by the Contractor at no additional cost to the Authority.

(3) If base course is dry, moisten it by sprinkling with as much water as it will readily absorb and so that moisture penetrates to a depth of at least 1/2 inch. Where necessary, in the opinion of the Engineer, commence such sprinkling or thorough wetting from 12 to 36 hours prior to placing concrete. Remove any standing pools of water before placing concrete.

(4) If the base is asphalt concrete or asphalt stabilized and either the ambient temperature is greater than 75 degrees F or the asphalt surface temperature is above 90 degrees F, whitewash the base surface with white pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

b. Slipform Construction

(1) The base course and subbase course on which the concrete will be placed shall be widened to extend beyond the paving machine track to support the paver without displacement.

(2) After the base course is placed and compacted, test the surface for smoothness in the presence of the Engineer. Test smoothness using a 10-foot straight edge laid in successive positions 5 feet on-center parallel to the centerline of the pavement. Advance the straight edge along the pavement in movements not exceeding 5 feet. Correct base course surface smoothness deviations exceeding 1/4 inch by removing and replacing the base full-depth in the deficient area.

(3) Test the base course for vertical deviations from required grades. Run levels at intervals of 50 feet longitudinally and transversely to determine the elevation of the finished base course. Correct vertical deviations exceeding 0.04 foot by removing and replacing the base full-depth in the deficient area. Submit test results to the Engineer in writing for approval before placement of concrete.

(4) Moisten base course and whitewash as set forth in 3.01-A.1.a (3) and (4).

2. Unbonded Concrete Overlays

a. Side-Form Construction

(1) Remove asphalt pavement in areas shown on the Contract Drawings by milling, scraping or scarifying and chipping.

(2) Repair underlying pavement as directed by the Engineer.

(3) On milled asphalt surfaces, whitewash the surface with white-pigmented curing compound meeting the requirements of Section 03301, entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200-square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

(4) Where shown on the Contract Drawings, place an asphalt concrete leveling course as shown on the Contract Drawings. Asphalt concrete shall conform to Section 02561 entitled "Asphalt Concrete Paving (FAA)", or Section 02551 entitled "Asphalt Concrete Paving".

(5) Where an asphalt concrete leveling course is required and the ambient temperature is 75 degrees F or greater, whitewash the surface with a white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to the depositing of concrete.

b. Slipform Construction

(1) Remove asphalt pavement in areas shown on the Contract Drawings by milling, scraping or scarifying and chipping.

(2) Repair underlying pavement as directed by the Engineer.

(3) On milled surfaces or on an asphalt leveling course, whitewash the surface with white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

(4) Where shown on the Contract Drawings, place an asphalt concrete leveling course as shown on the Contract Drawings. Asphalt concrete shall conform to Section 02561 entitled "Asphalt Concrete Paving (FAA)", or Section 02551 entitled "Asphalt Concrete Paving".

(5) Where an asphalt concrete leveling course is required and the ambient temperature is 75 degrees F or greater, whitewash the surface with a white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to the depositing of concrete.

3. Bonded Concrete Overlays

a. Remove asphalt pavement in areas shown on the Contract Drawings by milling, scraping or scarifying and chipping.

b. All surfaces that will be in contact with concrete shall be abrasive blasted or shot blasted within 8 hours of the start of concrete placement or if the area was open to vehicular traffic after final closure of the traffic prior to concrete placement, but not more than 8 hours before placement of overlay.

c. After removal and abrasive blasting, thoroughly clean concrete surfaces of dust, concrete particles, slurry produced by wet sawing or wet scarifying and other debris by oil-free air blast followed by water blast to the satisfaction of the Engineer. Remove all standing water. Complete surface cleaning just prior to placing concrete.

d. Abrasive blasting shall conform to the applicable requirements of Section 02574 entitled "Abrasive Blasting of Pavements".

e. The prepared surface will be tested for bond strength in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

f. In the event that full-depth slab repair is required by the Engineer in areas found to be deteriorated, preparation for concrete shall not commence on newly placed slabs earlier than 14 days after placement of base slab concrete or until the concrete has attained a compressive strength of 4,000 psi.

g. Moisten prepared surface immediately prior to placing concrete. Remove any standing water or pools.

B. Placing Forms

1. Prior to setting of forms, the Engineer will approve the preparation of the base or existing pavement upon which the concrete is to be placed.

2. Form sections shall be tightly locked and shall be free from play or movement in any direction. Stake forms into place with not less than 3 pins for each 10-foot section. Place a pin at each side of every joint. Set forms so that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Clean and oil forms prior to the placing of concrete.

3. Check alignment and grade of forms and make corrections prior to placing concrete. Form alignment and grade shall meet the requirements set forth in 1.04 B and C.

4. Straighten bent dowels, whether placed under this Contract or by others, using tools approved by the Engineer. Do not apply heat to dowels.

5. Clean forms, dowels and all steel which will be embedded in concrete, of all loose rust, scale, paint and other objectionable materials. Coat forms with non-staining mineral oil or other approved material before each use.

6. Check all form locking devices to ensure that they are in place and properly secured.

7. Do not place concrete until the Engineer has approved the form work and the base course or existing pavement upon which the concrete is to be placed.

3.02 APPLICATION

A. Pavement Joints

1. Furnish and install materials for joints as specified herein and in Section 02578 entitled "Pavement Joint Sealing".

2. The type, size, shape and location of joints shall be as shown on the Contract Drawings.

3. Construct all joints true to line with their faces perpendicular to the surface of the pavement. Joints shall vary by not more than 1/2 inch from line and shall be true to line with not more than 1/4-inch variation in 10 feet from their designated position. The vertical surface of the pavement adjacent to all formed joints shall be finished to a true plane and edged to a radius of 1/8 inch or as otherwise shown on the Contract Drawings.

4. Joint filler shall be supported in the support assembly perpendicular to the slab surface, shall be set below the surface of the slab to accommodate the sealant, and the top edge of the joint filler shall be protected during concrete placement by a metal channel cap.

5. Contraction joints shall be saw cut. To saw cut contraction joints use a two stage sawing operation. A chalk line or other suitable guide shall be used to mark the alignment of the joint. The first stage saw cut shall be one saw blade in width and to the depth shown on the Contract Drawings. Sawing shall commence as soon as the concrete has reached its final set and cutting does not chip, spall or tear the concrete regardless of weather conditions. Have on hand a sufficient number of saws and cut all joints in one continuous operation. The saw shall produce a cut that does not ravel or damage the concrete 1/8 inch beyond the edge of the sawcut. Immediately after saw cutting, thoroughly flush the joint with water to remove all waste from sawing. Have on hand one standby saw in good working order and an ample supply of saw blades at the construction site at all times during sawing operations. Perform second stage saw cuts not sooner than 72 hours after concrete is placed or curing is completed, whichever is less. Second stage sawing shall cut the slot required for the joint sealer to the dimensions shown on the Contract Drawings.

6. Plan each day's operations to end against a temporary bulkhead, at a contraction joint or at a thickened edge joint.

7. Where required on the Contract Drawings, form keyways in the plastic concrete by means of side forms. The keyway shall be formed to a tolerance of 1/4 inch in any direction. The dimension of the keyway forms shall vary by not more than plus or minus 1/4 inch from the mid-depth of the pavement.

B. Dowels and Tie Bars

1. Place dowels of required size and type at locations shown on the Contract Drawings.

2. Set all dowels and tie bars accurately, parallel to the pavement surface and, except for skewed or irregular joints, perpendicular to the pavement joint. The maximum permissible tolerance on dowel bar alignment and position shall meet the requirements of 1.04 E.

3. At all contraction joints and construction joints, apply a thin even film of lubricating oil to one-half of each dowel, unless the dowels are coated with a shop applied bond breaker.

4. Support dowels and tie bars rigidly using approved assemblies capable of holding dowels or tie bars and joint filler in position during the entire construction operation.

5. Install dowels and tie bars in existing or previously placed concrete as follows:

   a. Core drill holes in existing concrete. Do not use impact or percussion drills if spalling of the concrete occurs.

   b. Clean out hole and grout dowels and tie bars in place in accordance with the grout manufacturer's printed instructions.

   c. Coat exposed portions of dowels with lubricating oil, unless the dowels are coated with shop applied bond breaker.

6. Tie bars shall consist of deformed bars installed in joints as shown on the Contract Drawings. Place tie bars at right angles to the centerline of the concrete slab and space them at intervals shown on the Contract Drawings. They shall be held in position parallel to the pavement surface and in the middle of the slab depth. When tie bars extend into an unpaved lane, they may be bent against the form at construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, lubricated or enclosed in sleeves.

C. Placing Concrete

1. General

a. Unless otherwise specified on the Contract Drawings, the Contractor has the option of side-form or slipform paving.

b. At any point in the concrete conveyance, the free vertical drop from one point to another or to the underlying surface shall not exceed 3 feet.

c. Place concrete only in the presence of the Engineer and by methods approved by the Engineer.

d. Place concrete for full-depth pavement on a moistened surface, but take precautions to prevent water from entering and ponding where concrete is being placed or setting.

2. Side-Form Method

a. For the side-form method, deposit concrete in such a manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, place and spread concrete using an approved mechanical spreading device that prevents segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels – not rakes. Do not allow workers to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substance.

b. Deposit concrete as near to expansion and contraction joints as possible without disturbing them but do not dump concrete from the discharge bucket or hopper onto a joint assembly unless the hopper is centered above the joint assembly.

c. Thoroughly consolidate concrete against and along the faces of all forms and previously placed concrete and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Do not permit vibrators to come in contact with a joint assembly.

3. Slipform Method

a. Place concrete with an approved crawler-mounted, slip-form paver designed to spread, consolidate and shape the freshly placed concrete in one complete pass of the machine so that a minimum of hand finishing will be necessary to achieve a dense and homogeneous pavement in conformance with requirements of the Contract Drawings and Specifications. Place concrete directly on top of joint assemblies to prevent them from moving when the paver moves over them. Side forms and finishing screeds shall be adjustable to the extent required to achieve the specified pavement edge and surface tolerance. The side forms shall be of dimensions, shape and strength to support the concrete laterally for a sufficient length of time so that no edge slumping exceeds the requirements set forth in 1.04 G. Complete final finishing while the concrete is still in the plastic state.

b. In the event that slumping or sloughing occurs behind the paver or if there are any other structural or surface defects which, in the opinion of the Engineer, cannot be corrected within specified tolerances, immediately cease paving operations until proper adjustment of the equipment or satisfactory procedures and pavement are achieved. Complete the balance of the work with the use of standard metal forms and the formed method of placing and curing. Any concrete not corrected to permissible tolerances shall be removed and replaced at no cost to the Authority.

c. Operate the slipform paver on staked string lines on each side of the paver to control vertical and horizontal placement. The string line shall consist of piano wire and shall be supported as required to prevent sag.

D. Concrete Placing and Finishing Equipment

1. Side-Formed Pavements 8-Inches Thick or Greater

a. Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. Use internal vibrators to effectively consolidate concrete for the full paving width without causing segregation. The rate of vibration of internal type vibrators shall be not less than 7,000 cycles per minute. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than one foot from the vibrating element. Furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

The previous criteria relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

b. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

c. Check all vibrators prior to the start of Work and a minimum of twice daily to verify that they are working properly.

d. Provide manual tools, such as bull floats, trowels, straight edges, brooms and other similar hand tools.

2. Side-Formed Pavements Less than 8-Inches Thick

a. For pavements less than 8 inches thick vibrating surface pans or screeds will be allowed. Operating frequencies for surface vibrators shall be as required to achieve uniform consolidation without excess latents being developed at the surface of the finished concrete.

b. Provide manual tools, such as bull floats, trowels, brooms and other similar hand tools.

c. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

d. Check all vibrators prior to the start of work and periodically during construction progress to verify that they are working properly.

3. Slipform Paver

The slipform paver shall be equipped with traveling side forms of sufficient dimensions, shapes and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section.

a. The slipform paver shall be operated and manned by personnel experienced and trained on the operation of the equipment.

b. The slipform paver shall, when arriving at the construction site and at each time the paver is transported from one location to another, be thoroughly inspected and checked, by an experienced person, preferably the manufacturer's representative, for misalignment, warping, breakage or inadvertent changes in the settings of various control elements. This shall include inspecting the configuration of the main screeds when in paving position. Perform inspections in accordance with the recommendations of the manufacturer of the slipform paver used for the Work.

c. The slipform paver shall be of a type that permits vertical adjustment of side tracks so that where there is existing pavement, the machine can operate with one track placed on the existing pavement and the other placed on the subgrade.

d. The slipform paver will be subject to approval by the Engineer prior to starting paving operations. The paver shall be self-propelled and designed for the specific purpose of placing, screeding, consolidating and finishing concrete pavement slabs true to grade and cross-section in one complete pass without the use of fixed forms. The slipform paving machine shall be equipped with electronically controlled devices to control the grade and alignment of the finished surface from wire lines on both sides of the paver regardless of the condition of the surface the paver is traveling upon. The paver shall be equipped with means for spreading the concrete to a uniform depth before it enters the throat of the paver. The paver shall vibrate the concrete internally with sufficient intensity to consolidate the concrete throughout its entire depth and width. The paver shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. It shall weigh at least 2200 pounds per foot of paving lane width and be powered by an engine having at least 6.0 horsepower per foot of lane width. Vibrators shall be the internal type. Operating frequency for internal vibrators shall be between 8,000 and 12,000 vibrations per minute. Average amplitude for the internal vibrators shall be 0.025-0.05 inches. The number, spacing, and frequency shall be sufficient to achieve a dense and homogeneous pavement and to meet the recommendations of ACI 309 "Guide for Consolidation of Concrete". Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. Provide an electronic or mechanical means to monitor vibrator status. Check vibrator status a minimum of two times per day or when requested by the Engineer.

E. Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the Contract Drawings. For pavement thickness of 12 inches or more, install reinforcement steel by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the hardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit corrected horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have reached initial set shall be removed and replaced with newly mixed concrete. Initial set is defined as concrete, which cannot be worked with a vibrator. For pavement less than 12 inches thick, position reinforcement on suitable chairs securely fastened to the base prior to concrete placement. Vibrate concrete after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coating which could impair the bond between the steel and concrete. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

F. Consolidation and Finishing

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as set forth in 3.02 C.2.c. After the concrete has been placed and vibrated adjacent to the joints, operate the paver or finisher in a manner to avoid damage to or misalignment of joints. If uninterrupted operations of the paver or finisher, to, over and beyond the joints, cause segregation of concrete or damage to or misalignment of joints, the paver or finisher shall be stopped when the screed is approximately 10 inches from the joint. Segregated concrete shall be removed from the front of and off the joint; and the forward motion of the paver or finisher shall be resumed. Thereafter, the paver or finisher may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

2. The concrete shall be spread as soon as it is placed, and it shall be struck off and screeded by a paver or finisher. The machine shall go over each area once. When side forms are used, the tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling or other variation tending to affect the precision finish. During operation of the paver-finisher, maintain a uniform ridge of concrete ahead of the front screed for its entire length. When in operation, the paver-finisher shall be moved forward, always moving in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the striking-off process. The finished surface shall be uniform in texture, true to grade and cross section and free from porous areas. Wetting the surface to facilitate finishing will not be permitted.

3. Hand finishing methods will not be permitted, except under the following conditions: in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on grade; in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded. Use an approved portable screed. Provide a second screed for striking off the bottom layer of concrete when reinforcement is used.

4. Apply water-fog or evaporation retardant immediately after the concrete has been worked with the paver or finisher, as set forth in Section 03301 entitled "Portland Cement Concrete, Long Form".

5. Use bull floats sparingly.

6. While the concrete is still plastic, test for trueness with a 16 foot straightedge swung from handles 3 feet longer than one-half the width of the slab. Hold the straightedge in contact with the surface in successive positions parallel to the centerline and go over the whole area from one side of the slab to the other, as necessary. Advance in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. Cut down and refinish high areas. Give special attention to ensure that the surface across joints meets the smoothness requirements set forth in 1.04 D. Straightedge testing and surface corrections shall continue until the entire surface is free from observable departures from the straightedge and until the slab conforms to the required grade and cross section.

7. Any paver or finisher operation which requires appreciable hand finishing shall be immediately stopped and proper adjustments made or the equipment replaced.

G. Surface Texturing

Apply broom finish to all horizontal surfaces, unless otherwise shown on the Contract Drawings, subject to the following:

1. Apply finish when the water sheen has practically disappeared and before applying the curing compound.

2. Use push broom or floor brush type, not less than 18 inches wide and made of good quality bass or bassine fibers not more than 4-1/2 inches long and with handles longer than half the width of the slab.

3. Provide adequate number of brooms to keep up with other operations. When high early strength concrete is used, give extra care and attention to ensure proper finish is applied prior to initial set of the concrete.

4. Wash and thoroughly dry brooms at frequent intervals and remove worn or damaged brooms from the construction site.

5. Draw broom across previously finished surface from the centerline to each edge of the paving strip with a slight overlap of strokes.

6. Corrugations thus made in surface shall be uniform in appearance, approximately 1/16 inch in depth and not more than 1/8 inch in depth.

7. Complete brooming before initial set of concrete and before concrete is in a condition in which the surface will be torn or unduly roughened.

H. Edging

Immediately following surface texturing, carefully finish the edges of slab along sides and at joints with an approved edging tool to form a smooth rounded surface of 1/8-inch radius and subject to the following:

1. Where corners or edges of slabs have crumbled and at any locations which have leaked sufficient mortar to make proper finishing difficult, remove loose fragments and soupy mortar, and fill solidly with a mixture of correct proportions and consistency and finish.

2. Edges shall be smooth, to line and free of unnecessary tool marks.

I. Removal of Forms

Removal of forms shall be subject to the following:

1. Exercise care not to damage concrete.

2. Do not remove until approved by Engineer.

3. Do not remove sooner than 12 hours after placing concrete except for concrete with an initial cure time of 6 hours.

4. After removal of forms, patch areas of concrete which, in the opinion of the Engineer, show excessive honeycomb by cutting out defective areas and by keying and refilling them with a mortar of cement, water and sand in the same proportions as those in the concrete.

5. After forms are removed, cure sides of slabs in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

3.03 FIELD TESTS

A. Smoothness Testing

1. Longitudinal Direction

a. The Engineer will use a lightweight profilometer meeting the requirements of ASTM E 950 Class 1 to measure the pavement surface profile.

b. The profile will be measured prior to opening the pavement to normal operations. Sweep the pavement prior to profilometer testing.

c. The profilometer test results will be used to simulate California profilograph testing of the pavement. The simulation will be used to compute the Profile Index in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. A straight line moving average smoothing filter with a filter length of 3.00 feet will be used.

d. Testing will be performed on a lot basis. A lot is defined as an area consisting of 500 linear feet of consecutive full width of pavement in the longitudinal direction. When less than 250 feet remains after dividing the pavement into 500 linear foot lots, the remaining length will be added to the adjacent lot. If no adjacent lot exists or when more than 250 feet remains a short lot will be tested.

e. Measurements will be made along the each wheel path, 2 feet off lane line of each lane and in shoulder areas to within 12 inches of the barrier parapet. The average of the profile index values for each of the left and right wheel path for each lane will be used as the result for the lot and it must not exceed 15.0 inches per mile for each lane.. Additional profiles may be taken only to define the limits of an out-of-tollerance surface variation.

f.

g. The Profile Index for the length of paving lane in each lot is converted to the Profile Index of the lot in inches per mile using the following formula:

$$PI = PT \times \frac{5280}{L}$$

Where:

PI	=	Profile Index, inches per mile
PT	=	Profile Index, inches per length in feet of paving lane in a lot
L	=	Length of the paving lane in the lot in feet

2. Transverse Direction

a. A lot is defined as 50,000 square feet of final paved surface. Where paving areas are not equally divisible into 50,000 square foot lots, odd sized lots between 25,000 and 75,000 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 50,000 square foot lots.

b. Each lot will be evaluated by the Engineer with a 10-foot rolling straightedge provided by the Contractor and subject to approval by the Engineer. The Engineer at his sole discretion may elect to use a lightweight profilometer and straightedge simulation in lieu of rolling straightedge testing. Measurements will be made perpendicular to the centerline of the paving lanes at the center of each slab. Designed breaks in grade shown on the Contract Drawings will not be included in the measurements. When measurements within a lot exceed the tolerance specified in 1.04 D, correct the deficiency in accordance with 3.05 A.

B. Final Surface Grade Testing

1. Roadways

The grades of the final surface of each lot will be measured at the finished grade locations shown on the Contract Drawings. A lot is defined as 15,000 square feet of final pavement surface. Where paving areas are not equally divisible into 15,000 square foot lots, odd sized lots between 7,500 and 22,500 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 15,000 square foot lots. Perform the survey jointly with the Engineer.

3.04 PROTECTION AND CURING

A. Protect concrete against defacement, loss of moisture and rapid temperature changes for at least seven days (except for concrete that has initial cure time of less than seven days) from the beginning of curing operations. Protect unhardened concrete from rain and flowing water. Protection shall include, but not be limited to:

1. Have all equipment and materials required for adequate protection and curing on hand ready for installation, prior to commencing concrete placement. Failure to make such provisions or failure to properly protect and cure concrete will be the cause for immediate suspension of concreting operations.

2. Immediately after form removal, protect and cure sides of slabs exposed by such removal, in the same way as provided for slab surfaces.

3. Do not use any covering material that has become contaminated with sugar, tannic acid or any other substance detrimental to Portland cement concrete.

4. Keep concrete surfaces wet at all times when covering materials are not in place.

B. Curing

Cure concrete in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

C. Use of Pavement

1. Do not use new pavement for construction equipment and provide such barricades as may be required to prevent the entrance of traffic on concrete slabs until fully cured.

2. The Engineer may allow traffic on concrete slabs earlier if tests of the samples of concrete taken during the placing of the slab show that the concrete has attained a minimum flexural strength of 550 psi.

3. If only the paver or finisher is to be carried on a previously placed slab in order to place concrete in adjacent lanes, a minimum flexural strength of 400 psi will be sufficient. Take precautions to prevent damage to the previously placed concrete.

3.05 CORRECTION OF DEFICIENCIES

A. Deficiencies in Surface Smoothness

1. Make corrections as specified in 3.05 D at no cost to the Authority in the event of the following:

a. Longitudinal direction - The Profile Index exceeds 22.0 inches per mile, or the surface profile deviations exceed 0.4 inch in 25 feet, when tested in accordance with 3.03 A.1 unless the Engineer elects to accept the deficient surface subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 D.

B. Deficiency in Final Surface Grade

Make corrections as specified in 3.05 D at no cost to the Authority in the event of the following:

1. 15 percent of all measurements in a lot exceed the requirements of 1.04 C, when tested in accordance with 3.03 B.

2. Any individual measurement exceeds a grade tolerance of 0.06 foot when tested in accordance with 3.03 B.

3. Following the correction of deficiencies, the Engineer will retest the final surface of the concrete. In the event grade tolerance is exceeded, make additional corrections at no cost to the Authority.

C. Other Deficiencies

1. Remove and replace full concrete slabs in full depth pavement or bonded and unbonded overlays as specified in 3.05 D.3 and at no additional cost to the Authority if any of the following deficiencies exist in the finished pavement:

   a. Percent Within Tolerance Limits (PWL) for flexural strength is below 55 when calculated as specified in Section 03301 entitled "Portland Cement Concrete, Long Form".

   b. Percent Within Tolerance Limits (PWL) for thickness is below 55 percent when calculated in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form" using thicknesses measured after any required diamond grinding.

   c. Slabs exhibiting any cracks prior to opening the pavement to aircraft or normal operations, except as provided in Section 03301 entitled "Portland Cement Concrete, Long Form".

   d. Percent Within Tolerance Limits (PWL) for bond strength is below 55 when calculated in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

   e. For quick curing concrete if the initial flexural strength does not meet the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

   f. For slipform concrete if the edge slump requirements of 1.04 G are not met.

   However, the Engineer may elect to accept the deficient concrete. In that case, if the Engineer and Contractor agree in writing that the concrete shall not be removed, it will be paid for at 50 percent of the Contract unit price as specified in Section 03301 entitled "Portland Cement Concrete, Long Form".

2. Remove and replace bonded overlays if more than 5% of a lot is found to be delaminated, when tested in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form". Remove and replace delaminated concrete as approved by the Engineer.

D. Corrections

1. Remove and replace, or diamond grind, pavement deficient in surface smoothness, or final surface grade tolerance in accordance with all applicable requirements of the Contract Drawings and this Section, at times approved by the Engineer, so as not to interfere with operations of the Authority or others using the area.

2. Diamond Grinding

a. Diamond grinding may be used to correct deficiencies in surface smoothness and surface grade tolerance subject to approval by the Engineer. However, if removal of more than 3/4 inch of pavement is required to correct any deficiency, the deficient area shall be removed and replaced.

b. The diamond grinding equipment shall be as approved by the Engineer and shall have a minimum grinding head of 36 inches and 54 to 59 diamond blades per foot of shaft.

c. Where grinding is required, grind the entire width of the pavement by the length of defective area. If, in the sole opinion of the Engineer, the deficiencies are closely spaced and grinding individual areas will adversely affect ride, grind the entire pavement surface.

d. Perform grinding prior to joint sealing and grooving.

e. Dispose of slurry produced from grinding operations off Authority property.

f. Perform diamond grinding, if required, at no additional cost to the Authority.

3. Remove and Replace Slabs

a. Remove and replace shall mean the removal of an entire slab or slabs even if the deficient area is only a portion of a slab.

b. Where removal is required, all edges of the slab or slabs shall be saw-cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. Following edge sawcutting the slab shall be further divided by sawcutting full depth, at appropriate locations, and each piece lifted and removed. Suitable equipment shall be used to provide a vertical lift, and approved safe lifting devices shall be used for attachment to slab sections. No mechanical in-place breakers shall be used for slab removal.

c. Install dowels of the same size and spacing as shown on the Contract Drawings, using drilling and grouting procedures specified in 3.02 B.5.

d. Repair any damaged base as directed by the Engineer.

e. Clean the surfaces of all joint faces of loose materials and contaminates. Coat all joint faces with a double application of curing compound. Do not allow curing compound to touch dowel bars.

f. Place concrete as specified for original construction.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Notwithstanding other adjustments to Contract compensation or corrections specified herein for various deficiencies, no payment will be made for material that must be removed to correct deficiencies, or for that material placed in excess of the plus tolerance for the total thickness of concrete course as specified in 1.04 A.

B. The assigned unit price for concrete shall be one hundred thirty dollars ($130.00) per cubic yard or, in the case of Classified Work, the actual Contract unit price bid for the appropriate concrete item in the Schedule of Unit Prices For Classified Work.

C. Adjustments for surface smoothness and final surface grade will be based on the final test results, which are measured after the correction of deficiencies. Reductions in payment will be determined by the following:

$R = A \times T \times D \times F \times 0.037$

Where:

R =	Reduction in payment per lot for surface smoothness or final surface grade, dollars
A =	Area of lot, square feet
T =	Design Thickness of Pavement in feet
D =	Price per CY of concrete, assigned unit price or Contract unit price as set forth in 4.01 B.
F =	Contract Unit Price Adjustment Factor specified in 4.02 A and 4.02 B.

Reductions in payment for failure to meet surface smoothness and final surface grades are calculated separately for the entire pavement or overlay surface. Deductions from Contract compensation are made for the requirement (surface smoothness or final surface grade), which results in the greatest payment reduction. Reductions for surface smoothness or final surface grade are in addition to all other adjustments to Contract compensation.

D. When the Engineer elects to adjust Contract compensation in lieu of correcting areas with deficiencies in surface smoothness, the Contract Unit Price Adjustment Factor specified in 4.01 C will set at 0.10.

4.02 ADJUSTMENT TO CONTRACT COMPENSATION FOR PAVEMENT DEFICIENCIES

A. Deficiency in Final Surface Grade Tolerance

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Exceeding Final Surface Grade Tolerance" by entering the appropriate row with the percentage of all measurements within a lot which exceed the grade tolerance, measured in accordance with 3.03 B, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR EXCEEDING FINAL SURFACE GRADE TOLERANCE	
Measurements Exceeding Grade Tolerance (Percent)	Contract Unit Price Adjustment Factor
0.0 – 5.0	0
5.1 – 10.0	0.05
10.1 – 15.0	0.25
15.1 and up	Corrective Work required as specified in 3.05.B.

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 C.

B. Deficiency in Surface Smoothness

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Surface Smoothness" by entering the appropriate row with the Profile Index, measured and calculated in accordance with 3.03 A.1, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR SURFACE SMOOTHNESS	
Average Profile Index (inches per mile)	Contract Unit Price Adjustment Factor
0.0 - 15.0	0.00
15.1 - 16.0	0.02
16.1 - 17.0	0.04
17.1 - 18.0	0.06
18.1 - 20.0	0.08
20.1 - 22.0	0.10
22.1 and up	Corrective Work required as specified in 3.05 A

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 C.

END OF SECTION

SECTION 02510

PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02510A01 Submit detailed working drawings of formwork

Samples

02510C01 Sample of the joint dowel assembly

02510C02 Sample of the preformed bituminous joint filler

Product Data

02510D01 Submit name of manufacturer and model number of the paver-finisher

Inspection Reports

02510O01 As per 1.05 B, Submit written results to the Engineer after each test of the final surface of each day"s paving after initial curing is completed

02510O02 As per 1.05 C, Submit to the Engineer written survey results prior to scheduling concrete placement for final surface grade side-form construction

02510O03 As per 1.05 D, Submit to the Engineer written survey results prior to scheduling concrete placement for final surface grade slipform construction

02510O04 As per 3.01 A. 1. b. 3, Submit to the Engineer written results of testing the base course for vertical deviations from required grades before placement of concrete

END OF APPENDIX "A"

DIVISION 2

SECTION 02553

ASPHALT CONCRETE PAVING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for plant mix macadam base course, bottom course, top course, bridge deck membrane, tack coat and overlay of existing pavement with asphalt concrete using performance graded asphalt specified in 2.02 B.

B. Except as in 1.01 C below, recycled asphalt concrete pavement (consisting of reclaimed asphalt pavement blended with new materials) may be used to the maximum percentages specified in 1.04 C.2.b.

C. Recycled asphalt concrete shall not be used in mixes where modified asphalts or "Rosphalt 50" additive are used.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M320	Performance-Graded Asphalt Binder.
AASHTO R028	Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV).
AASHTO T313	Method of Test for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR).
AASHTO T315	Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).
AASHTO T048	Method of Test for Flash and Fire Points by Cleveland Open Cup.
AASHTO T240	Method of Test for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test).

American Society for Testing and Materials (ASTM)

ASTM C 88	Test Method For Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTM C 117	Test Method for Materials Finer than 75-micrometres (No. 200) Sieve in Mineral Aggregates by Washing.
ASTM C 127	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
ASTM C 128	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.

ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C 566	Test Method for Total Evaporable Moisture Content of Aggregate by Drying.
ASTM C 1252	Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced By Particle Shape, Surface Texture, and Grading).
ASTM D 75	Practice for Sampling Aggregates.
ASTM D 242	Specification for Mineral Filler for Bituminous Paving Mixtures.
ASTM D 692	Specification for Coarse Aggregate for Bituminous Paving Mixtures.
ASTM D 979	Practice for Sampling Bituminous Paving Mixtures.
ASTM D 995	Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
ASTM D 1073	Specification for Fine Aggregate for Bituminous Paving Mixtures.
ASTM D 2041	Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
ASTM D 2172	Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures.
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D 2726	Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
ASTM D 3203	Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
ASTM D 3549	Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
ASTM D 3666	Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
ASTM D 4125	Test Methods for Asphalt Content of Bituminous Mixtures by the Nuclear Method.
ASTM D 4318	Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4402	Test Method for Viscosity Determinations of Asphalt at Elevated Temperatures Using a Rotational Viscometer.
ASTM D 4791	Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
ASTM D 4867	Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.
ASTM D 5444	Test Method for Mechanical Size Analysis of Extracted Aggregate.
ASTM D 5821	Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
ASTM D 5976	Specification for Type 1 Polymer Modified Asphalt Cement for Use in Pavement Construction.

ASTM D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer.
ASTM D 6307	Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method.
ASTM D 6926	Practice for Preparation of Bituminous Specimens Using Marshall Apparatus.
ASTM D 6927	Test Method for Marshall Stability and Flow of Bituminous Mixtures.
ASTM E 178	Practice for Dealing With Outlying Observations.
ASTM E 950	Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
ASTM E 1274	Test Method for Measuring Pavement Roughness Using a Profilograph.
	Asphalt Institute – Manual Series
MS-2	Mix Design Methods for Asphalt Concrete, and Other Hot-Mix Types.
MS-20	Asphalt Hot-Mix Recycling.
	Dept. of Transportation – Federal Aviation Administration (FAA)
FAA ERLPM	*Eastern Region Laboratory Procedures Manual.*

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Apply tack coat only when the base surface is dry and the ambient temperature in shade has not been below 32 degrees F for 12 hours immediately prior to application, unless otherwise approved by the Engineer.

2. Do not place asphalt concrete upon a wet or frozen surface.

3. The minimum laydown temperature shall be 310 degrees F or greater when the base surface temperature is 50 degrees F or less and not less than 275 degrees F when the base temperature is greater than 50 degrees F. Measure the asphalt concrete temperature in the truck, at the paver.

4. For asphalt mixes containing "Rosphalt 50", the minimum laydown temperature is 350 degrees F, regardless of the base surface temperature. Measure the asphalt concrete temperature in the truck, at the paver.

5. The minimum allowable base temperature for a lift thickness is shown in the following table:

Nominal Lift Thickness (inches)	Minimum Allowable Base Temperature (degrees F)
2 or greater	32
1-1/2 or greater, but less than 2	40
Less than 1-1/2	50

6. If nominal lift thickness is two inches or greater and the base temperature is below 32 degrees F, the Engineer may approve paving operations if the Contractor can demonstrate, prior to commencing with paving, that density and mat texture uniformity can be achieved. All other requirements apply.

7. In case of sudden rain, the Engineer may at his sole discretion permit placing of mixture already in transit from the plant, provided the surface to be paved is free from pools of water and laydown temperatures conform to the above tabulation. Such permission, however, shall not be interpreted as a waiver of any of the quality requirements.

8. When using design mixes containing "Rosphalt 50" retain the services and arrange for a technical representative of the "Rosphalt 50" manufacturer to be present in the field during the first three days of installation of "Rosphalt 50" paving mix.

B. Asphalt Concrete Mix Design

1. Design asphalt concrete job mix formula based on the "Mix Design Table" specified in 2.03 A and specimen compaction temperature specified in 1.04 E.3.

2. Design top and bottom courses and bridge deck membrane to the following target values: [1]

Marshall Stability at 75 blows (ASTM D 6927) - 2150 lbs., min. except 1,000 lbs, min. for bridge deck membrane

Flow Value, 0.01 inch gradation (ASTM D 6927) - 8 to 16, except 15 to 40[2] for bridge deck membrane

Marshall Air Voids, Percent, (ASTM D 3203)[3]:

Top course (except Mix I-6A, and mixes containing "Rosphalt 50")	2.8 to 4.2
Top course, Mix I-6A	5.3 to 6.7
Bottom course	3.8 to 5.2
Bridge Deck Membrane	1.5 Max.
Mixes containing "Rosphalt 50"	0 to 2.0

Percent Voids Filled with Asphalt:

Mix I-2A; I-4A; I-5A; PA-5	70 to 80
Mix I-4; I-5; I-6A	65 to 80
Bridge Deck Membrane	95 to 100
Mixes containing "Rosphalt 50"	90 to 100

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1 For asphalt concrete mixes with five percent of the aggregate or greater retained on the 1" sieve, the Engineer may require the use of six-inch molds to increase the repeatability of Marshall test results. For six-inch molds Marshall stability shall be 4800 lbs. minimum at 113 blows with 22.5 lb. hammer and 18-inch drop and the flow value shall be within the 12 to 24 range.

2 Flow may be higher than 40 if other properties meet section requirements and if approved by the Engineer.

3 Determine by comparing bulk specific gravity (ASTM D 2726) to maximum specific gravity (ASTM D 2041).

Voids in the Mineral Aggregate (VMA), Percent, Minimum:

Mix I-2A	12
Mix I-4A	13
Mix I-4; PA-5	14
Mix I-5; I-5A	16
Mix PA-5 with "Rosphalt 50"	16
Mix I-5A with "Rosphalt 50"	18
Mix I-6A	19
Bridge Deck Membrane	20

3. Plant mix macadam base course (Mix I-1) shall be a mixture designed within the gradation limits specified in 2.03 A. When approved by the Engineer, bottom course (Mix I-2A) may be used in lieu of Mix I-1 provided it meets all requirements for bottom course.

4. The design job mix formula shall indicate definite percentages passing for each sieve fraction of aggregate and the asphalt content.

5. Design new job mix formula for each asphalt plant used, whenever there is a change in material or when field conditions dictate a need for redesign.

6. When required by the Engineer, determine the tensile strength ratio of specimens of the composite paving mixture by procedures specified in ASTM D 4867. The value shall be not less than 80 percent.

C. Plant Production Requirements

1. The asphalt concrete mixture or its components shall not be heated to a temperature outside the limits specified in 3.02 A.

2. Top and bottom courses and bridge deck membrane, shall have 100 percent of the material in each lot equal, exceed or fall within the range of the following acceptance limits*:

   Marshall Stability at 75 blows (ASTM D 6927) - 1800 lbs. min, except 1000 lbs. minimum for bridge deck membrane

   Flow Value, 0.01 inch gradation (ASTM D 6927) - 8 to 16, except 15 to 40** for bridge deck membrane

   If the Percent of Material Within Tolerance Limits (PWL) of the lot is less than 90 percent, corrections for deficiencies in Marshall Stability and Flow shall be made as set forth in 3.03 C.

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* If six-inch molds are required as set forth in 1.03 B.2, Marshall stability shall be 4000 lbs. minimum at 113 blows with 22.5 lb. hammer, 18-inch drop and the flow value shall be within the 12 to 24 range.
** Flow may be higher than 40 if other properties meet Section requirements and if approved by the Engineer.

3. Modified Asphalt Performance Grade

Modified asphalt shall meet the performance grade requirements set forth in 2.02 B, when tested in accordance with 1.04 E.12. When material fails to meet the requirements, make corrections in accordance with 3.03 E.

4. Marshall Air Voids

The target bands for Marshall air voids shall be as set forth in 1.03 B.2. Acceptance shall be on a lot basis as specified in 1.04 E.3. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL) as set forth in 4.03 B.5. Adjustment to Contract compensation will be made if the PWL of the lot is less than 90 percent as set forth in 4.03 D. If the PWL of the lot equals or exceeds 90 percent and the PWL for pavement joint density for the lot equals or exceeds 90 percent, the percentage adjustment to compensation will be between 100 and 106 as set forth in 4.03 D.

The Tolerance Limits for Marshall air voids, percent, (ASTM D 3203) are:

Top course, (except Mix I-6A)	2.0 to 5.0
Top course, Mix I-6A	4.5 to 7.5
Bottom Course	3.0 to 6.0
Bridge deck membrane	1.5 Max.
Mixes containing "Rosphalt 50"	0 to 2.0

5. Tensile Strength Ratio

The Tensile Strength Ratio shall meet the requirement set forth in 1.04 E.15. When material that is produced fails to meet the requirements, make corrections in accordance with 3.03 F.

6. Retain the services and arrange for a technical representative of the "Rosphalt 50" manufacturer to be present in the plant during the first three days of production.

D. In-Place Pavement Requirements

1. Surface Smoothness

a. Longitudinal direction for roadways where paving lane lengths equal or exceed 500 linear feet.

The final surface shall have a Profile Index of 15.0 inches per mile or less and no deviations 0.4 inch or greater in 25 feet. Testing and acceptance will be on a lot basis as set forth in 1.04 E.10.a. Make corrections for deficiencies in surface smoothness as set forth in 3.03 A. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.03 E.

b. Longitudinal direction for roadways where paving lane length is less than 500 linear feet.

Final surface shall be smooth and free of irregularities greater than 1/8 inch when tested with a 10-foot straight edge. Testing and acceptance will be on a lot basis as set forth in 1.04 E.10.b. Make corrections for deficiencies in surface smoothness as set forth in 3.03 A. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.03 E.

c. Longitudinal and transverse direction for parking lots and port container storage areas.

The final surface shall not exhibit ponding of water and shall be free-draining. Testing and acceptance will be as set forth in 1.04 E.10.c. Make corrections for deficiencies as set forth in 3.03 A.

2. Density

a. In-Place Mat Density

The target for in-place mat density is 98 percent or better (97 percent for pavement on roadway structures). Acceptance will be on a lot basis as set forth in 1.04 E.5. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL), as set forth in 4.03 B.5. Adjustment to Contract compensation will be made based on the PWL of the lot as set forth in 4.03 C. The lower tolerance limit for pavement mat density is 96.3 percent (95.7 percent for pavement on roadway structures).

a. In-Place Joint Density

The target for in-place joint density is 97 percent or better (96 percent for pavement on roadway structures). Acceptance will be on a lot basis as set forth in 1.04 E.6. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL), as set forth in 4.03 B.5. Adjustment to Contract compensation will be made based on the PWL of the lot for surface course only as set forth in 4.03 F. The lower tolerance limit for pavement joint density is 93.3 percent.

b. Plant mix macadam base course shall have stone thoroughly interlocked, interstices reduced to a minimum, and creeping of mixture no longer visible and with no further increase in density achievable by additional rolling.

3. Thickness

a. Pavement courses shall conform to thicknesses shown on the Contract Drawings within the following tolerances:

Course or Combination of Courses	Tolerance (in inches) Plus or Minus*
Thickness of top or membrane course	1/4
Total thickness of top course and bottom course	1/4
Total thickness of plant mix macadam base course, bottom course, and top course	1/4
Overlay thickness shall be measured by the tolerance in 1.03 D.4	--

* All measurements for this purpose shall be to the nearest 1/8th inch.

4. Final Surface Grade

The final surface shall conform to the finished grades shown on the Contract Drawings within a target tolerance for vertical deviation of plus or minus 0.04 foot, except where closer tolerance is required for proper functioning of appurtenant structures and drainage. The final surface abutting existing pavements shall smoothly transition to the existing surface grades and shall not exhibit ponding of water. The Engineer will test the final surface, which will be accepted or rejected on a lot basis as set forth in 1.04 E.11. The Engineer will adjust Contract compensation based on the percentage of grade measurements exceeding the target tolerance as set forth in 4.03 D. For all areas when 15 percent or more of the grade measurements exceed the target grade tolerance or where any individual measurement exceeds a 0.06-foot grade tolerance, make corrections for deficiencies in final surface grade as set forth in 3.03 D.

5. In-Place Air Voids

Asphalt concrete shall have in-place air voids between 2.0 percent and 8.0 percent (9.0 percent for bottom course and materials placed on roadway structures). Asphalt concrete containing "Rosphalt 50" additive shall have in-place air voids less than 6.0 percent. The Engineer will test in-place air voids in accordance with 1.04 E.7. When material fails to meet the requirements, make corrections for deficiencies in accordance with 3.03 B.

1.04 QUALITY CONTROL/ASSURANCE

A. General

1. Establish, provide and maintain an effective quality control system which shall ensure that the materials and completed construction submitted for acceptance conform to Contract requirements whether manufactured or processed by the Contractor or procured from subcontractors or vendors.

2. Pre-Paving Construction Meeting

   a. A pre-paving meeting will be conducted at the construction site by the Engineer a minimum of 20 days prior to the first day of laydown to discuss Contractor (suppliers) mixes, plant quality control, field quality control, tack coat, control strip, requirements for mat and joint densities, equipment (including rollers, Material Transfer Vehicle and paver), smoothness and grade control, segregation, workmanship, quality assurance testing, incentive and disincentive criteria and any other pertinent specified requirements.

   b. Record, type and distribute meeting minutes to all attendees of the meeting within 5 days of the date of the meeting.

   c. Do not schedule the pre-paving construction meeting until all submittals pertaining to the paving operation have been submitted and approved.

3. At no additional cost to the Authority, make arrangements for the project superintendent and a qualified representative to be present at every segment of the paving operations, including, but not limited to the following:

   a. Asphalt Producer's Quality Control Manager.

   b. Contractor's representative for site quality control testing.

c. Paving crew foreman.

d. Smoothness testing personnel.

e. Survey crew chief.

4. Submit to the Engineer certification in writing stating that all of the testing equipment to be used is properly calibrated and will meet the specifications applicable for the specified test procedures. Upon Engineer's request, test samples to demonstrate an acceptable level of performance.

5. Perform quality control sampling, testing and inspection during all phases of the Work at rates sufficient to ensure that the Work conforms to the Contract requirements, and at minimum test frequencies required by 1.04 D.

B. Quality Control Plan

1. Establish and maintain a Quality Control Plan (Plan) along with all the personnel, equipment, supplies and facilities necessary to obtain samples, perform and document tests and meet specification requirements. For Contracts requiring 1,000 tons of asphalt concrete or more, the Plan is required. For Contracts requiring less than 1,000 tons of asphalt concrete, the Plan is not required.

2. Describe the Plan in a written document. Submit the written Plan to the Chief of Materials Engineering, Materials Engineering Unit for review at least 28 calendar days prior to the start of paving operations.

3. In the absence of an approved Quality Control Plan, the Authority will make no payments for materials, which are subject to specific quality control.

4. The Plan may be operated wholly or in part by the Contractor or by an independent organization but it shall in all cases remain the responsibility of the Contractor.

5. Plan Contents: The Plan shall be organized to address at least the following items:

a. Quality control organization chart.

b. Area of responsibility and authority of each individual.

c. Names and qualifications of personnel as required by 1.04 B.7.d.

d. A listing of any outside organizations such as testing laboratories that will be employed by the Contractor and a description of the services they will provide.

e. A testing plan which lists the tests required to be performed by the Contractor, the frequency of testing, sampling locations and the location of the testing facilities.

f. Procedures for ensuring that tests are performed in accordance with the testing plan, that they are documented and that proper corrective actions are taken when necessary.

g. Procedures for ensuring that testing equipment is available, that it complies with specified standards and that it has been calibrated against certified standards.

h. Procedures for verifying that tests are taken in accordance with the appropriate AASHTO and ASTM standards.

i. Procedures for daily submittal of test results to the Engineer.

j. An action plan detailing procedures to be used to correct unsatisfactory production processes and construction practices, when tests indicate materials fail to meet specifications for any of the following:

(1) Aggregate gradation.

(2) Mat and joint density.

(3) Marshall air voids.

(4) Surface smoothness.

(5) Grades.

6. Plan Elements: The Plan shall address all elements which affect the quality of the pavement including but not limited to:

a. Mix Design.

b. Aggregate Gradation.

c. Quality of Materials.

d. Stockpile Management.

e. Proportioning / Temperature Control of Mixture Components.

f. Mixing and Transportation.

g. Placing and Finishing.

h. Joints.

i. Compaction.

j. Surface smoothness and grades.

7. Quality Control Organization

a. Implement the Quality Control Plan by the establishment of a separate Quality Control Organization. Develop and submit an organization chart to show all quality control personnel integrated with other management, production, and construction functions and personnel.

b. The organization chart shall identify all quality control staff required to implement all elements of the quality control program, including inspection and testing functions for different items of work.

c. If an outside organization or independent testing laboratory is used for implementation of all or part of the Plan, the personnel assigned will be subject to the qualification requirements of 1.04 B.7.d. The organization chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

d. The Quality Control Organization shall consist of at least the following personnel:

(1) *Plan Administrator*

The Plan Administrator shall be an employee of the Contractor. The Plan Administrator shall have prior quality control experience on a project of size and scope comparable to those of this Contract. In addition, the Plan Administrator shall meet one of the following requirements:

(a.) Licensed Professional Engineer with one year of asphalt paving experience as approved by the Engineer.

(b.) Engineer-in-Training with two years of asphalt paving experience as approved by the Engineer.

(c.) An individual with three years of highway and/or airport paving experience as approved by the Engineer and with a Bachelor Degree in Civil Engineering, Civil Engineering Technology or Construction.

(d.) Construction Materials Technician certified at Level III by the National Institute for Certification in Engineering Technologies (NICET).

(e.) Highway Materials Technician certified at Level III by NICET.

(f.) Highway Construction Technician certified at Level III by NICET.

(g.) A NICET certified Engineering Technician in Civil Engineering Technology with 5 years of asphalt paving experience as approved by the Engineer.

Certification at an equivalent level by a State or nationally recognized organization will be acceptable in lieu of NICET certification. The Plan Administrator shall have full authority to institute any and all actions necessary for the successful operation of the Plan to ensure compliance with the Specifications. The Plan Administrator shall report directly to a responsible officer in the Contractor's organization. The Administrator may supervise Plans on more than one project provided that he can upon request be at the construction site within one hour.

(2) Quality Control Technicians

Provide a sufficient number of Quality Control Technicians to adequately implement the Plan. Quality Control Technicians shall be engineers, engineering technicians, or experienced craftsmen holding a current certificate issued by the New Jersey Society of Asphalt Technologists, Inc. (NJSAT) or other Engineer-approved certifying agency or organization. (Information regarding the certification procedure can be obtained by contacting NJSAT.)

The Quality Control Technicians shall report directly to the Plan Administrator and shall perform the following functions:

(a.) Inspection of all plant equipment used in proportioning and mixing to ensure proper calibration and operating conditions.

(b.) Performance of quality control tests necessary or desirable to adjust and control mix proportioning in accordance with the job mix formula.

(c.) Inspection of all equipment used in placing, finishing and compacting material to ensure proper operating condition.

(d.) Inspection during construction to ensure placement, joint construction and compaction is in conformance with the Specifications and will produce a finished product that meets Specification requirements.

(e.) Performance of all quality control testing as required by 1.04 D, including density monitoring.

8. Testing Laboratory

a. The Plan must provide for a fully equipped asphalt laboratory located at the plant or construction site. It shall be available for joint use by the Contractor for quality control testing and by the Engineer for acceptance testing and must have adequate equipment for the performance of the tests required by these Specifications. The Engineer shall have priority in use of the equipment necessary for acceptance testing.

b. The effective working area of the laboratory shall be a minimum of 250 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70 degrees F plus or minus 5 degrees F.

c. In addition to the equipment required for testing, the laboratory shall be equipped with a paper copier and facsimile machine to be utilized by the Engineer.

d. Keep laboratory facilities clean and maintain all equipment in proper working condition. Allow the Engineer unrestricted access to inspect the Contractor's laboratory facility and to witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies or testing personnel and procedures. When in the Engineer's opinion deficiencies may adversely affect test results, immediately suspend delivery and placement of asphalt materials and do not resume until the deficiencies are satisfactorily corrected.

9. Noncompliance

In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the Contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, the Engineer may order the Contractor to replace ineffective or unqualified quality control personnel.

C. Source of Aggregate and Sampling

1. Virgin Aggregate

a. Select sources of virgin aggregates well in advance of the time the materials are required for the construction. When the aggregates are obtained from a previously approved source, submit random hot bin samples, if requested by the Chief of Materials Engineering, Materials Engineering Unit, a minimum of 14 calendar days prior to the start of production and if from a source not previously approved, submit random hot bin samples a minimum 45 calendar days prior to the start of production. Sampling of the hot bin materials for job mix formulation will be observed by the Engineer and identical samples will be obtained for verification of the job mix formulation by the Authority's Materials Engineering Unit. The Engineer may require the proposed mix formulation to be batched at the asphalt plant and tested in the presence of the Engineer.

b. Where previously used or concurrent job mix formulations are to be used, the taking of hot bin samples may be waived by the Engineer.

2. Reclaimed Asphalt Pavement

a. Where reclaimed asphalt pavement material is permitted, it shall have 100 percent passing 1/2 inch sieve and shall be a mixture of only coarse aggregate, fine aggregate, and asphalt cement, free of solvents or other contaminating substances. The fine aggregate contained in the reclaimed asphalt pavement shall have a plasticity index not greater than 4 when tested in accordance with ASTM D 4318.

(1) Maintain stockpiles of reclaimed asphalt pavement in a manner to prevent contamination with other aggregates and keep covered in order to maintain a low moisture content of the reclaimed asphalt pavement.

b. Unless otherwise shown on the Contract Drawings, the maximum proportion of reclaimed asphalt pavement permitted within each mix shall be 10 percent for top and bottom courses and 25 percent for base course.

c. Contractor's reclaimed asphalt pavement will be considered for use provided that the Engineer is notified of the intended use and that he approves the reclaimed asphalt pavement. Take at least six representative samples, each at least 7 pounds, from each stockpile. Each stockpile shall not exceed 3000 tons. Sample in accordance with ASTM D 75. Sampling will be observed by the Engineer. Take duplicate samples and submit them with mix design for verification. Test samples in accordance with ASTM D 2172 to determine asphalt cement content; test recovered aggregate in accordance with ASTM C 136 for gradation.

d. Once a reclaimed asphalt pavement stockpile has been approved for use, the stockpile shall be dedicated to the Contract and no reclaimed asphalt pavement may be added to the stockpile. If there is an insufficient amount of reclaimed asphalt pavement in the stockpile to complete the Work, a new, separate stockpile may be made and shall be tested for acceptance as aforementioned.

3. Locate stockpiles of reclaimed asphalt pavement and of new aggregate so as to prevent intermingling.

4. When more than one asphalt plant is to be used to supply asphalt concrete to the construction site, each asphalt plant shall use a similar job mix formula, as approved by the Engineer.

5. Locations and timing of random sampling will be determined by the Engineer in accordance with Section 6 of FAA ERLPM.

D. Contractor's Quality Control Tests

1. Perform all quality control tests necessary to control the production and construction processes. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, Marshall properties and temperatures. Obtain samples at the direction of the Engineer for the purpose of quality control testing. Random sampling procedures specified in Section 6 of FAA ERLPM shall be used for determining the selection of samples as follows:

a. Take four samples of freshly mixed material per each lot (one sample from each sublot) for top, bottom, and base courses and bridge deck membrane. Take samples in accordance with ASTM D 979 from material at the mixing plant.

A lot will be defined as one day's production for each mix. Production rates for each mix will be obtained by the Engineer from the asphalt plant at the start of each day's production. A sublot will be defined as a quarter of a lot based on the initial production forecast for the mix. Maximum lot size will be 2000 tons. If a day's production is forecast over 2000 tons, the forecast quantity shall be divided into two or more equal lots. Should actual production be greater than the initial forecast of production for a given mix, the additional production will be divided into the same sublot sizes as initially calculated. If one or two additional sublots are produced they will be added to that days lot with n=5 or 6 for sublots. If three or more additional sublots are produced in a day, an additional lot will be established for that particular day.

If actual production is less than the initial forecast for a given mix but sufficient material was produced to constitute three sublots, a lot will be formed with three sublots (n=3). Should actual production constitute only one or two sublots, the sublots will be added either to the previous lot or the next production lot, whichever is closer in time. Each sublot shall contain a minimum of 75 tons of material.

Where more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

b. Test samples to determine asphalt content in accordance with ASTM D 2172, D 4125 or D 6307. Test recovered aggregate to determine gradation in accordance with ASTM D 5444. In addition, when automated recording plants are used, submit printouts of asphalt content to the Engineer.

c. Prepare three plugs from each sample and test them in accordance with ASTM D 6926 using automatic compaction procedures. Determine Marshall air voids in accordance with ASTM D 3203. For each sublot, determine the maximum theoretical density in accordance with ASTM D 2041.

Voids filled with asphalt, for each plant sample, shall be computed as follows:

(1) Determine asphalt content in percentage by volume (I) using:

$$I = \frac{P_b \times G_{mb}}{G_b}$$

Where:

I = Percentage by volume of asphalt

Pb = Percentage by weight of asphalt

Gmb = Bulk specific gravity of compacted mixture

Gb = Specific gravity of asphalt

(2) Determine percent voids filled with asphalt (VF) as follows:

$$VF = \frac{I \times 100}{I + P_a}$$

Where:

VF = Percent voids filled with asphalt

I = Percentage by volume of asphalt.

P_a = Percent Marshall air voids

Estimate voids in the Mineral Aggregate (VMA) by adding the asphalt content in percentage by volume to the percent of air voids. Use bulk specific gravities to calculate VMA.

d. Take hot bin or feeder belt composite samples of top, bottom and base course aggregates and bridge deck membrane mixes at least twice daily and check gradation in accordance with ASTM C 136, including washing material passing No. 8 sieve in accordance with ASTM C 117.

e. At least six times daily, check and record temperatures at necessary locations to determine the temperatures of:

(1) aggregates and asphalt immediately before introduction to the pugmill or dryer drum;

(2) the mixture immediately after discharge from the pugmill or dryer drum;

(3) the mixture at the spreader on the construction site.

f. Reclaimed Asphalt Pavement

(1) Where reclaimed asphalt pavement is being used as a substitute for some of the virgin aggregate, take a sample of freshly mixed recycled asphalt concrete in accordance with ASTM D 979 and determine the moisture content at least twice daily. Moisture determinations shall be based on the weight loss, determined by heating an approximately 4-pound sample of the freshly mixed materials for one hour in an oven at 280 plus or minus 5 degrees F. The moisture content of the freshly mixed recycled asphalt concrete shall not exceed 0.5 percent.

(2) Take a sample of reclaimed asphalt pavement from the approved stockpile at least once daily and test in accordance with ASTM D 2172 to determine asphalt content and gradation in accordance with ASTM D 5444. The resulting asphalt content and aggregate gradation shall be similar to the average test results of the reclaimed asphalt pavement submitted with job mix formula. If there is a variation of plus or minus 1.0 percent in the asphalt content or plus or minus 10 percent in aggregate gradation on any sieve, a second sample shall be taken and tested in the same manner as the first sample. If the results are similar to that of the first sample, take appropriate measures to adjust the mixture to compensate for the variation in the reclaimed asphalt pavement.

g. Moisture Content of Aggregate

For the drum plants the moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

h. Moisture Content of Mixture

The moisture content of the mixture shall be determined once per lot in accordance with the procedure given in 1.04 D.1.f (1). The moisture content in the freshly mixed asphalt concrete shall not exceed 0.5 percent. If the moisture content is 0.5 percent or greater, then stop production and adjust plant operation.

i. Perform additional testing as required to ensure that mixtures produced meet the requirements of this Section.

2. Control Charts

Maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content. When test results exceed certain limiting values, take action to bring the asphalt concrete production process under tighter control. The Action Limit is the limiting value at which corrective actions shall be made while production may continue. The Suspension Limit is the limiting value at which production must be suspended while corrections are made. Production shall not resume until Contractor's corrections are approved by the Engineer.

Post control charts in a location satisfactory to the Engineer and keep charts current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter and the Contractor's test results. Use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If in the Engineer's opinion the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. Individual Measurements

Establish control charts for individual measurements to maintain process control within tolerance for aggregate gradation and asphalt content. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS		
Sieve	Action Limit	Suspension Limit
1"	±6%	±9%
3/4"	±6%	±9%
1/2"	±6%	±9%
3/8"	±6%	±9%
No. 4	±6%	±9%
No. 8	±5%	±7.5%
No. 16	±5%	±7.5%
No. 30	±3%	±4.5%
No. 50	±3%	±4.5%
No. 100	±2%	±3%
No. 200	±2%	±3%
Asphalt Content	±0.45%	±0.7%

b. Range

Establish control charts for range to control process variability for the test parameters and Suspension Limits listed below. Compute the range for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, adjust the Suspension Limits by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

CONTROL CHART LIMITS BASED ON RANGE	
(Based on n = 2)	
Sieve	Suspension Limit
1"	11 %
3/4"	11 %
1/2"	11 %
3/8"	11 %
No. 4	11 %
No. 8	9 %
No. 16	9 %
No. 30	6 %
No. 50	6 %
No. 100	3.5 %
No. 200	3.5 %
Asphalt Content	0.8 %

c. Corrective Action

The Quality Control Plan shall indicate that appropriate action shall be taken when the asphalt concrete production process is out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and shall describe Contractor's actions to bring the process into control. A process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two consecutive points fall outside the Action Limit line for individual measurements.

3. Document quality control efforts using copies of the sample forms contained in the FAA ERLPM, Appendix C, in its entirety, or use Authority forms obtained from the Engineer. Make test results available to the Engineer daily.

4. If a storage silo is used:

a. Check the silo to see that it can properly store the asphalt concrete for the time involved.

b. Take samples of asphalt concrete as it is unloaded from the silo and check them for conformance to this Section. If the asphalt concrete appears segregated, stop using the storage silo until it is demonstrated to the Engineer that the condition has been corrected.

c. Silo storage time is governed by previous State DOT approval, not to exceed 24 hours.

5. Unless otherwise noted on the Contract Drawings, and subject to the approval of the Engineer, select an area to be called a Control Strip from the first day's production of each mix. Each Control Strip shall be a minimum of 100 feet long and two spreader widths wide and shall be constructed to meet the requirements of this Section and in the same manner as the remainder of the course it represents. Take three random samples at the plant and test them for stability, flow and air voids in accordance with 1.04 D.1.c. Take three randomly selected cores from the pavement mat and three along the longitudinal pavement joint and test them to determine density in accordance with 1.04 E.5 and E.6. Use the same means and methods which will be used to construct longitudinal and transverse joints as referred to in 1.04 B.6.h and 3.02 F.1 and F.2.

The purpose of the Control Strip is to demonstrate that the pavement may be constructed using the proposed equipment and methods of operation and to obtain all quality requirements prior to the start of full production. Construct a new Control Strip whenever there is a change in equipment, methods of operation or type or source of material or whenever there is a change in the job mix formula. The Control Strip may become part of the completed pavement if it meets the requirements of this Section.

6. Include, as part of the Quality Control Plan, the use of a nuclear density device to aid in meeting the specified target densities. Calibrate the nuclear density device with the control strip cores. If other than a nuclear density device is used it shall be calibrated with an additional set of pavement cores.

7. Surface Smoothness

Perform quality control smoothness testing of the final surface. For paving lanes 500 feet or greater in length, the testing equipment shall be capable of measuring the Profile Index of the final surface, in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. As a minimum test the final surface of pavement, along the center of each paving lane once during each day of paving. Submit written test results to the Engineer after each test. Test results shall identify the location of each test including starting and end stations and offset from centerline of pavement. For paving lanes less than 500 feet, test the centerline of the paving lanes with a 10-foot long straightedge capable of marking locations which exceed the surface smoothness tolerance. Upon completion of all quality control testing and any required corrective work, the Engineer, in accordance with 1.04 E.10, will perform acceptance testing.

8. Final Surface Grade

Perform quality control surveys immediately after the top course has been compacted, to check final grades. Measure elevations at the finished grade locations shown on the Contract Drawings. Provide the Engineer with the survey results at the completion of each work period. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01 foot, required finished grades from the Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control; acceptance of the finished surface shall be as specified in 1.04 E.11.

9. For Work performed, either wholly or in part, in the State of New Jersey, provide a representative present during all paving operations who shall be certified by the New Jersey Society of Asphalt Technologists, Inc. (NJSAT) as an Asphalt Paving Construction Technologist.

E. Engineer's Sampling and Testing

1. Produce asphalt concrete in approved automated plants equipped with interlocks and printouts meeting the requirements of ASTM D 995 and subject to the following:

   a. Plant interlocks and printouts shall be in operation during production and two (2) copies of all printouts shall be furnished to the Engineer daily.

   b. Have scales certified by an approved agency at least every 180 calendar days. Submit copies of certifications to the Engineer upon request.

2. Provide labor and equipment to take samples, except cores, to check thickness and density.

3. The Engineer will perform acceptance testing for Marshall air voids, stability and flow. Samples will be taken from trucks at the plant, in accordance with FAA ERLPM, Section 6. These samples will be from the sublots that were sampled in 1.04 D.1.a. The Engineer will prepare three plugs from each sample and test them in accordance with ASTM D 6927 using automatic compaction procedures. The specimen compaction temperatures will be within the following range as measured within 1/2 inch from the outside edge:

Performance Grade	Temperature Degrees F
PG 64-22, PG 70-22	275 - 295
PG 76-22	300 - 320
PG 82-22	305 - 325
PG 64-22 in mixes containing "Rosphalt 50"	390 - 410

Air voids, voids in mineral aggregate and voids filled with asphalt will be determined in accordance with ASTM D 3203 and 1.04 D.1.c. The average test values obtained from each lot of top and bottom courses and bridge deck membrane must conform to the parameters specified in 1.03 C.

In lieu of sampling and testing in the field, the Engineer may sample and perform acceptance testing at the plant. The Contractor will be advised at the start of Work where the Engineer will sample and test.

4. For thickness determination, exclusive of overlay and bridge deck membrane pavement, the Engineer will divide each course into area lots consisting of the area covered by the lot sampled as specified in 1.04 D.1.a and he will further subdivide each lot into four equal sublots. The Engineer will take one 4-inch diameter core randomly in each sublot to check thickness of the top and bottom courses. One-fourth of all such cores will continue through the plant mix macadam base course. Thickness will be determined in accordance with ASTM D 3549.

   For bridge deck membrane, the Engineer will verify the thickness by measuring with an appropriate measuring device through the newly placed membrane course. After the measurement has been obtained, the locations shall be re-sealed to prevent any leakage.

5. Mat Density

   a. The Engineer will determine the in-place density of the Control Strip and subsequently placed pavements by taking cores at random locations as specified below.

   b. Cores taken from the top and bottom courses and bridge deck membrane in place and any other specimens taken at the construction site, sampled in accordance with the random sampling procedures as specified in 1.04 D.1, will be tested by the Engineer for bulk specific gravity in accordance with ASTM D 2726. Cores will not be taken closer than one foot from a transverse or longitudinal joint for pavement mat density determination. The in-place density of the pavement course will be the ratio of the in-place specific gravity to the laboratory Marshall bulk specific gravity expressed as a percentage.

   c. Cores taken from courses containing more than 10 percent air voids will be tested by the Engineer for density (Bulk Specific Gravity) according to the following equation:

$$S.G. = \frac{W}{12.87\, d^2 h}$$

S.G.	=	Bulk Specific Gravity
W	=	Weight, Dry Specimen (grams)
d	=	Measured Diameter* (inches)
h	=	Measured Height* (inches)

   Laboratory bulk specific gravity and computation of in-place density will be as specified in 1.04 E.5.b above.

* Average of 5 equally spaced measurements around the core

d. The average in-place density determination, taken from the area covered by the lot sampled as specified in 1.04 D.1.a, will be determined by the Engineer by summing up the sublot in-place density readings obtained from a lot and dividing the total by the number of sublots. The in-place density from each sublot will be obtained using a core reading taken from each sublot on a random basis and dividing by the Marshall bulk density (ASTM D 6926 and ASTM D 2726) taken for that sublot. Any core with a thickness less than twice the largest sieve size to retain more than 5 percent of any aggregate will be discarded and additional random cores will be taken as required to ensure representative readings.

e. The Engineer will repeat the procedure specified in a. through d. above whenever a change is made in the type or source of material or whenever a new job mix formula is approved for material from the same source.

6. Joint Density

The Engineer will take one joint core from each sublot of all surface courses or from the underlying lifts as defined in 1.04 D.1.a and will test it in accordance with 1.04 E.5. For joint cores the lowest Marshall bulk density for sublots forming the joint will be used to compute the in-place density. The Engineer will take cores from directly over the longitudinal joint in line with the location of the random cores taken under 1.04 E.5.b. When a paving lane has two longitudinal joints, both joints will be cored. The in-place joint density will be determined separately for each joint, and the joint producing the lowest in-place density will be used to determine payment. Based on site and placement conditions the Engineer may elect to core only one joint.

7. In-Place Air Voids

The Engineer will calculate the in-place mat air voids for each sublot in accordance with ASTM D 3203, by comparing the bulk specific gravity (ASTM D 2726) of the cores taken as specified in 1.04 E.5.b to the maximum laboratory specific gravity (ASTM D 2041).

8. Patch all areas where samples are taken with an approved asphalt concrete or Portland cement concrete properly tamped to fill all voids and struck off flush with the surface within 24 hours after sampling.

9. The Engineer may at any time, notwithstanding previous plant approval, reject and require the Contractor to dispose of any batch of asphalt concrete mixture which is rendered unfit for use due to contamination, segregation or incomplete coating of aggregate. Such rejection may be based on visual inspection, only. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer and, if the Contractor can demonstrate in the laboratory, in the presence of and to the satisfaction of the Engineer, that such material was erroneously rejected, the Contractor will be compensated for the material.

10. Surface Smoothness

a. Longitudinal direction for roadways where paving lane lengths equal or exceed 500 linear feet:

(1) The Engineer will test the final surface of the pavement parallel to the direction of paving for smoothness. A lightweight profilometer meeting the requirements of ASTM E 950 Class 1 will be used to measure the pavement surface profile.

(2) The profilometer test results will be used to simulate California profilograph testing of the pavement. The simulation will be used to compute the Profile Index in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. A third-order Butterworth low pass filter with a filter length (cutoff wavelength) of 2.0 feet will be used. Scallops will be rounded to the nearest 0.01-inch. The blanking band will be centered on a straight line determined by least - squares fit over the length of the lot. The simulation will also be used to identify any surface deviations in excess of 0.4 inch in 25 feet. Designed breaks in grade shown on the Contract Drawings will not be included in the Profile Index computations.

(3) Clean the pavement prior to testing. Testing will be performed on a lot basis. A lot is defined as 500 linear feet of paving lane. When less than 250 feet remains after dividing the pavement into 500 linear foot lots, the remaining length will be added to the adjacent lot. When more than 250 feet remains, a short lot will be tested.

(4) For paving lanes up to 20 feet in width, three measurements will be made along the centerline of paving lanes. The profile index of the lot will be computed by averaging the profile index of each measurement.

(5) For paving lanes greater than 20 feet in width, three measurements will be made at two locations, each six feet from and parallel to the centerline of the paving lane. The Profile Index of the lot will be computed by averaging the Profile Index of each of the two measured profiles.

(6) The Profile Index for the length of paving lane in each lot is converted to the Profile Index of the lot in inches per mile using the following formula:

$$PI = PT \times \frac{5280}{L}$$

Where:

PI = Profile Index, inches per mile

PT = Profile Index, inches per length in feet of paving lane in a lot

L = Length of the paving lane in the lot in feet

b. Longitudinal direction for roadways where paving lane lengths are less than 500 linear feet:

(1) The Engineer will evaluate each paving lane with a 10-foot long rolling straightedge, which marks the length of surface variations that exceed the required tolerance.

(2) The Contractor shall sweep the pavement prior to measurement.

(3) Measurement will be taken along the centerline of each paving lane.

(4) The Engineer will calculate the percentage of final surface which exceeds the required tolerance by dividing the measured length of the marked surface deficiencies by the total length of the paving lane.

c. Longitudinal and transverse direction for parking lots and port container areas:

(1) At the completion of paving, and in the presence of the Engineer, thoroughly cover the pavement with water using a water distribution vehicle. In areas that do not adequately drain the water from the surface, or hold water, remove and replace the deficient area as approved by the Engineer and in accordance with 3.03 A.

11. Final Surface Grade

The Engineer will measure grades of the final surface of each lot at the finished grade locations shown on the Contract Drawings. Where paving lanes are 20 feet or greater in width, an additional line of grades, located at the center of the paving lane and spaced at 25 feet longitudinally, will be measured. A lot is defined as 50,000 square feet of final pavement surface. The transverse limit of the lot will be the transverse limit of paving. Where paving areas are not equally divisible into 50,000 square foot lots, odd sized lots between 25,000 and 75,000 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 50,000 square foot lots. Perform the survey jointly with the Engineer.

12. The Engineer will perform acceptance testing of modified asphalt to determine whether it meets the performance grade requirements set forth in 2.02 B. Samples will be collected at the asphalt plant for each lot of asphalt concrete produced, as specified in 1.04 D.1.a. The Engineer will sample the liquid asphalt from the plant storage tanks which must be equipped with a sample valve.

13. The Engineer will measure the temperature of each load of asphalt concrete. Any load of asphalt concrete with temperature exceeding 350 degrees F will be rejected (excluding mixes that contain "Rosphalt 50" additive). For mixes containing "Rosphalt 50" additive, any load produced with temperature exceeding 500 degrees F will be rejected.

14. Where there is a discrepancy between the Contractor's test results and those of the Engineer, the Engineer's test results shall govern.

15. The Engineer may perform acceptance testing during production to determine whether the asphalt concrete meets the Tensile Strength Ratio (TSR) requirements of this paragraph. For each lot of asphalt concrete, defined in 1.04 D.1.a, one sample will be obtained from a truck at the plant and tested in accordance with ASTM D 4867. Suspend production if test results indicate that the TSR is less than or equal to 80 percent. Submit a plan to the Engineer for approval indicating how the problem will be corrected and ensure that TSR values greater than 80 percent will be consistently produced before commencing production once again.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer of asphalt cement shall be approved by either the New York State Department of Transportation (NYSDOT) or the New Jersey Department of Transportation (NJDOT).

B. Modified Asphalt shall be one of the following. No substitutions permitted.

1. "Stellarflex SP" - NuStar Asphalt Refining LLC; Paulsboro, NJ.
2. "Elvaloy RET" - DuPont Co.; Wilmington, DE.
3. "Kraton" - Kraton Polymers, LLC; Houston, TX.
4. "Polykote" - Suit-Kote Corp.; Cortland, NY.
5. "Vestoplast S" modifier - Evonik Degussa Corp.; Parsippany, NJ.

C. Additive shall be the following. No substitutions permitted.

1. "Rosphalt 50" additive - Chase Construction Products/Royston Div. of Chase Corp.; Pittsburgh, PA.

2.02 MATERIALS

A. Aggregates

1. If the tensile strength ratio of the specimens of composite mixture is less than 80 percent, as specified in 1.03 B.6, the aggregates will be rejected unless the Contractor treats the asphalt with an approved anti-stripping agent. The amount of anti-stripping agent added to the asphalt shall be sufficient to produce a tensile strength ratio of not less than 80 percent.

2. Coarse Aggregate: Material retained on the No. 8 sieve

a. Except for use in the top lift of the top course within the roadway pavement edge markings as shown on the Contract Drawings, coarse aggregate shall conform to ASTM D 692, except as follows: use broken stone or crushed gravel having not less than 75 percent by weight of pieces with two or more fractured faces and 85 percent by weight having at least one fractured face (ASTM D 5821), with a maximum of 8 percent of flat or elongated pieces (ASTM D 4791), with a maximum percentage of wear (ASTM C 131) of 40 percent and with a magnesium sulfate loss (ASTM C 88) of not more than 12 percent for a five-cycle test period.

b. For the top lift of the top course within the roadway pavement edge markings as shown on the Contract Drawings, coarse aggregate shall conform to ASTM D 692 except as follows: use broken stone which shall be trap rock or gneiss of uniform quality obtained from a source approved by the NYSDOT or the NJDOT for use in asphalt concrete. The aggregate shall have not less than 75 percent by weight of pieces with two or more fractured faces, with a maximum of 8 percent of flat or elongated pieces (ASTM D 4791), with a maximum percentage of wear (ASTM C 131) of 30 percent and with a magnesium sulfate loss (ASTM C 88) of not more than 12 percent for a five-cycle test period.

c. A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.

3. Fine Aggregate: Material passing the No. 8 sieve and retained on the No. 200 sieve

Fine aggregate shall be a blend of washed, textured sand and stone screenings conforming to ASTM D 1073 with a maximum percentage of wear (ASTM C 131) of 30 percent and with a magnesium sulphate loss (ASTM C 88) of not more than 18 percent for a five-cycle test period, a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318. When tested in accordance with ASTM D 2419, the sand equivalent value shall be 35 or greater.

Textured sand shall be defined as sand which when tested in accordance with ASTM C 1252, Method A, results in uncompacted voids greater than 45.0 percent. Sand that has a low texture value and slag shall not be used.

4. Mineral filler shall conform to ASTM D 242 and shall have a ratio to asphalt cement by weight not exceeding 1.2.

B. Asphalt

Asphalt shall be one of the following, conforming to the requirements of AASHTO M320 and as specified within table entitled "Requirements for Performance Graded Asphalts" for the Performance Grade (PG) as shown on the Contract Drawings.

1. Asphalt Cement

Asphalt cement shall meet the requirements for PG 64-22, unless otherwise shown on the Contract Drawings.

2. Modified Asphalt

Modified Asphalt shall be one of the following. No substitution is permitted.

a. "Kraton" (SEBS), "Polykote", "Elvaloy RET" or "Stellarflex SP" meeting the requirements for PG 76-22 or PG 82-22 as shown on the Contract Drawings.

b. Asphalt cement modified with "Vestoplast S", may be used where PG 76-22 is specified and subject to the following:

(1) Add "Vestoplast S" to the asphalt concrete mixture at a rate of 7 percent by weight of asphalt cement, by substitution.

3. Additive

Where "Rosphalt 50" is used in a mix design, add "Rosphalt 50" additive to the asphalt concrete mixture at a rate of 2.25 percent by weight of total mix.

C. Tack Coat

1. Unless otherwise shown on Contract Drawings, tack coat shall be asphalt cement as specified in 2.02 B.1 above.

2. For mixes containing "Rosphalt 50", use bond coat in place of tack coat as specified in Specification Section 02555.

D. Resultant Asphalt Cement

Resultant asphalt cement shall be a mixture of new asphalt cement as specified in 2.02 B.1 above, asphalt cement extracted from the reclaimed asphalt pavement and recycling agents if required.

REQUIREMENTS FOR PERFORMANCE GRADED ASPHALTS

PERFORMANCE GRADE (PG)	64-22	70-22	76-22	82-22
These Tests Performed on Original Binder:				
Flash Point Temperature (AASHTO T048): Minimum, Degrees Celsius.	230	230	230	230
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Minimum, 1.00 kPa, Test Temperature At 10 Rad/s, Degrees Celsius.	64	70	76	82
Rotational Viscosity (ASTM D 4402): Maximum, 3 Pa-s, Test Temperature, Degrees Celsius.	135	135	135	135
Separation Test - R&B (ASTM D 5976): Percent Difference Maximum Degrees Celsius.	--	--	4.5	4.5
These Tests Performed on Rolling Thin Film Oven Test (RTFOT) Residue:				
Mass Loss (AASHTO T240): Maximum Percent.	1.00	1.00	1.00	1.00
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Minimum, 2.20 kPA, Test Temperature at 10 Rad/s, Degrees Celsius.	64	70	76	82
Elastic Recovery (ASTM D 6084, Method A) 25 Degrees Celsius, 10 cm Elongation, Immediately Cut, 60 Minutes, Minimum Percent.	--	--	75	80
These Tests Performed on Pressure Aging Vessel (PAV) Residue:				
Pav Aging Temperature (AASHTO R028): Degrees Celsius.	100	100	100	100
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Maximum, 5000 kPa, Test Temperature at 10 Rad/s, Degrees Celsius.	25	28	31	34
Creep Stiffness (AASHTO T313): S, Maximum, 300 MPa m-Value, Minimum 0.300, Test Temperature at 60 Seconds, Degrees Celsius.	-12	-12	-12	-12

* Varies from the New Jersey Interagency Engineering Committee Standard

2.03 MIXES

A. Mix Design Table

Mix Designation and Percentage by Weight Passing Sieves								
Sieve Size	Bottom Course	Top Course						Bridge Deck Membrane
	I-2A	I-4A	PA-5	PA-5 with "Rosphalt 50"	I-5A	I-5A with "Rosphalt 50"	I-6A	
1 1/4"	100	---	---	---	---	---	---	---
1"	90-100	100	---	---	---	---	---	---
3/4"	70-84	78-98	100	100	---	---	---	---
1/2"	54-68	64-77	72-98	88-98	100	100	---	---
3/8"	44-54	52-67	60-82	74-84	80-100	90-100	100	100
No. 4	28-36	33-46	40-56	48-58	55-85	55-65	85-93	95-100
No. 8	17-25	27-35	31-39	30-40	32-42	35-45	74-82	71-79
No. 16	12-20	17-23	19-25	24-32	20-30	24-32	---	59-67
No. 30	7-15	12-18	13-19	16-24	12-22	16-24	50-58	47-55
No. 50	5-11	8-12	8-16	10-16	7-16	10-16	24-32	25-35
No. 100	3-9	6-10	5-10	6-10	3-12	6-10	9-15	14-22
No. 200	1-5	3-6	3-6	2-6	2-6	2-6	4-8	12-16
Asphalt, Weight by Percent of Total Mixture								
	3.5-4.5	4.4-5.2	5.2-6.2	***5.0	5.8-6.5	***5.0	6.5-8.00	8.00-9.00**

** Asphalt shall be modified asphalt as specified in 2.02 B.2 above and meet the requirements for PG 76-22.

*** Asphalt binder content prior to addition of "Rosphalt 50 LT". "Rosphalt 50 LT" shall be added to the mix at a rate of 2.25% by weight of the mix (aggregate + binder).

FROM NEW JERSEY INTER-AGENCY ENGINEERING COMMITTEE STANDARD BITUMINOUS CONCRETE MIXTURE DESIGN TABLE			
Mix Designation and Percentage By Weight Passing Sieves			
	Plant Mix Macadam Base Course	Top Course	
Sieve Size	I-1	I-4	I-5
1 1/2"	100	-----	-----
1"	90-100	100	-----
3/4"	60-80	95-100*	-----
1/2"	-----	75-95*	100
3/8"	15-40	65-85*	80-100
No. 4	0-10	35-65	55-75
No. 8	-----	25-50*	30-60*
No. 16	-----	18-40	20-45
No. 30	-----	12-30	15-35
No. 50	-----	10-23*	10-30
No. 100	-----	-----	-----
No. 200	-----	3-6*	3-8*
Asphalt, Weight by Percent of Total Mixture			
	2.5-3.1	5.2-6.5*	5.5-7.0*

Note No. 1 - Material passing the No. 200 sieve may consist of fine particles of the aggregate, mineral filler, or both. Material passing the No. 30 sieve shall be non-plastic when tested in accordance with the requirements of ASTM D 4318.

Note No. 2 - Lift Thickness shall be no less than two times the nominal maximum size of the aggregate (See Note No. 6).

Note No. 3 - If the aggregate does not satisfy tensile strength ratio requirements, add an approved anti-stripping agent (See 2.02 A.1).

Note No. 4 - Job Mix Formula shall follow a smooth curve within the specified limits for all sieve sizes of the Mix Design Table, but shall not fall on the maximum density line and shall not cross the maximum density line below the No. 4 sieve. The maximum density line will be determined by the Engineer by plotting the gradations on a .45 power graph paper, and drawing a straight line between the amount passing the No. 200 sieve and the amount, which is retained on the largest sieve.

Note No. 5 - Notify the Engineer if a satisfactory Job Mix formula using the Mix Design Table cannot be obtained.

Note No. 6 - Nominal maximum size is one sieve size larger than the first sieve to retain more than 10 percent of the aggregate, based on the Contractor's job mix formula.

* Varies from the New Jersey Interagency Engineering Committee Standard

B. Job Mix Formula and Checklist

1. The laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. Before construction starts, submit to the Engineer a certification signed by the manager of the laboratory stating that it meets these requirements. The certification shall contain as a minimum:

   a. Qualifications of personnel: laboratory manager, supervising technician and testing technicians.

   b. A listing of equipment to be used in developing the job mix.

   c. A copy of the laboratory's quality control system.

2. Develop Job Mix Formula using procedures contained in Chapter V, "Marshall Method of Mix Design" of the Asphalt Institute's Manual Series No. 2 (MS-2) and, where applicable, "Asphalt Hot-Mix Recycling", Manual Series No. 20 (MS-20); and furnish information for the following checklist:

   a. General

      (1) Contractor and Contract number.

      (2) Type of bituminous mixture.

      (3) Type and source of aggregates.

      (4) Type and source of asphalt.

   b. Aggregates

      (1) Sieve analysis of each aggregate to be used in mixture in accordance with ASTM C 136. The minus 200 fraction shall be tested by the laboratory or technician doing the mix design in accordance with ASTM C 117.

      (2) Physical test of aggregates - soundness, wear, percent fractured faces and percent flat or elongated particles.

      (3) Bulk specific gravity and absorption in accordance with ASTM C 127 for coarse aggregate and ASTM C 128 for fine aggregate. The aggregate shall be sampled by the laboratory or technician doing the mix design from the plant hot bins or feeder belt.

      (4) Proportion used of each type aggregate.

      (5) Theoretical gradation of combined proportions of aggregates.

   c. Asphalt

      (1) Type and grade.

      (2) Specific gravity.

      (3) Type of antistripping agent (if required).

   d. Optimum Asphalt Content Determination in accordance with ASTM D 1559

      (1) Compactive effort (75 or 113 blows applied to specimen, each face, as appropriate).

      (2) Actual specific gravity and unit weight of each specimen.

      (3) Percentage of asphalt in each specimen.

(4) Theoretical specific gravity of each specimen calculated.

(5) Graph of stabilities vs. asphalt content.

(6) Graph of flow values vs. asphalt content.

(7) Graph of voids filled with asphalt vs. asphalt content.

(8) Graph of Marshall air voids vs. asphalt content.

(9) Graph of voids in the mineral aggregate vs. asphalt content.

(10) Graph of unit weight vs. asphalt content.

(11) Visual description of specimens at optimum asphalt content (i.e., dry, flushing, etc.).

(12) Graph of Temperature vs. Viscosity of Asphalt.

e. Summation of Established Job Mix Formula

(1) Combined gradation of aggregates.

(2) Optimum asphalt content from above graphs.

(3) Specified job mix tolerance range.

(4) Mixing Temperature.

(5) Temperature of mix at point of discharge into haul units.

(6) Compaction Temperature.

f. Summation of the Characteristics of the Mixture at Optimum Asphalt Content

(1) Stability, pounds.

(2) Flow value, hundredths of an inch.

(3) Actual specific gravity of laboratory compacted mixture.

(4) Maximum specific gravity of paving mix at optimum asphalt content in accordance with ASTM D 2041.

(5) Total voids (air), percent, in laboratory compacted mixture.

(6) Voids filled with asphalt, percent, in laboratory compacted mixture.

(7) Voids in the mineral aggregate, percent, in laboratory compacted mixture.

(8) Actual unit weight (lbs./cu. ft.) of laboratory compacted mixture.

(9) Tensile Strength Ratio - ASTM D 4867.

g. Verification of Job Mix Formula Characteristics

Where the asphalt content for the proposed Job Mix Formula does not coincide with the asphalt content used in the trial specimens, prepare an additional set of specimens for the proposed Job Mix Formula asphalt content to verify that actual Marshall results duplicate those anticipated from the curves.

PART 3. EXECUTION

3.01 PREPARATION

A. Clean all underlying pavement surfaces and previous courses of all loose and foreign material by sweeping with hand brooms, power sweepers or blowers as directed by the Engineer. Remove permanent pavement markings and reflectors.

B. Verify that required grade and density tolerances of previous courses have been obtained before placing asphalt concrete.

C. Construct keyways for overlay pavements as shown on the Contract Drawings by using longitudinal or transverse cuts into the existing pavement and removing the necessary amount of pavement to provide a smooth transition from the new to existing asphalt concrete surfaces.

D. Tack Coat

1. Apply tack coat by brush on edges of all previously placed or existing pavement and surfaces of manholes and other structures that will be in contact with pavement course to be placed.

2. Apply tack coat by pressure distributor to existing pavement surface to receive new pavement course or where a course is not placed within 24 hours for roadway areas after placement of the underlying course, except as specified in 3.02 E.7 and 3.02 F.2. However, if the underlying pavement course has not been exposed to traffic and, in the opinion of the Engineer, has been kept clean, tack coat shall not be required when a course is placed beyond the time frame mentioned above.

3. Unless otherwise shown on the Contract Drawings, the tack coat shall be at an application rate and temperature range of 0.05 to 0.10 gallons per square yard and 275 to 350 degrees F, respectively. The tack coat application rate for Portland cement concrete surfaces shall be 0.10 to 0.15 gallons per square yard.

4. Protect structures such as manhole frames and covers, joints and steel faced curbs within areas to be tack coated, prior to tack coating, by masking them with tar paper, polyethylene film or other approved materials.

5. After the application of tack coat, follow immediately with placement of asphalt concrete pavement course. Take precautions necessary to maintain and protect the tack coated surface from damage until the next course is placed, including placement and removal of sand as necessary to blot up excess material.

6. All tack coated surfaces shall be paved or protected prior to opening the area to traffic.

E. Mixing Plant Requirements for Recycled Asphalt Concrete

1. Batch plants shall have an appropriately located metering device for adding the reclaimed asphalt pavement to the heated new aggregate and shall provide an accurate method for proportioning the reclaimed asphalt pavement into the mixture.

2. The batch plant's dryer may have to be operated at temperatures higher than with all new materials. If necessary, modify the dryer and the dust collection system to prevent damage.

3. Drum-mix plants shall have an appropriately located metering device for adding the reclaimed asphalt concrete to the dryer-mixer in a manner that does not damage the asphalt in the reclaimed material. Ensure that an accurate method for proportioning the reclaimed asphalt concrete into the mixture is provided. Make provisions for compensating for the moisture in the reclaimed asphalt concrete.

4. The mixing for a drum-mix plant shall be such as to achieve an intimate blending of the new and reclaimed materials and a complete coating of all aggregate particles.

5. At the Contractor's option, the batch or drum-mix plant may be equipped with a surge-storage bin at the mixture discharge point.

3.02 APPLICATION

A. Mixing in Plant

1. Place aggregate through a dryer and heat to temperature not exceeding 350 degrees F (excluding mixes that contain "Rosphalt 50" additive). For mixes containing "Rosphalt 50" additive, place aggregate through a dryer and heat to temperature not exceeding 550 degrees F.

2. Screen aggregate to appropriate fractions and place each fraction in a storage bin over mixer unit.

3. Use equipment conforming to ASTM D 995 for preparation of paving mixtures, except provide one bin for fine aggregate, three for coarse aggregate, and one for reclaimed asphalt pavement (if applicable).

4. Introduce aggregate into mixer at between 250 and 350 degrees F (between 450 and 500 degrees F for mixes containing "Rosphalt 50" additive) and dry mix for minimum of 5 seconds (7 seconds for mixtures containing "Vestoplast S", 10 seconds for mixes containing "Rosphalt 50" additive) before adding asphalt. Where reclaimed asphalt pavement or "Vestoplast S" is used, add to mixer after dry mixing and before asphalt cement. Where "Rosphalt 50" additive is used, add to the mixer during the dry mixing.

5. Heat asphalt to a temperature not exceeding 325 degrees F (350 degrees F for modified asphalt) and introduce it into mixer at a temperature of not less than 275 degrees F (300 degrees F for modified asphalt).

6. Mix as long as necessary, but not less than 30 seconds (not less than 70 seconds for mixes containing "Rosphalt 50" additive) after introduction of asphalt cement, to completely and uniformly coat aggregate particles.

7. Regulate temperature of mixture according to outdoor temperature and as necessary to meet minimum laydown temperatures specified in 1.03 A.3 and 4. However, asphalt concrete mix production temperatures leaving the plant shall be as follows:

Type of Asphalt	Temperature Degrees F
Asphalt Cement	275 - 325
Modified Asphalt – PG 76-22	305 - 335
Modified Asphalt – PG 82-22	310 - 340
Asphalt containing "Rosphalt 50"	410 - 450

Any deviation from these temperatures must be approved by the Chief of Materials Engineering, Materials Engineering Unit. Use of storage silos will be permitted provided such silos are approved as specified in 1.04 D.4.

B. Delivery, Placing and Spreading

1. Trucks used for hauling asphalt concrete mixtures shall have tight, clean and smooth metal beds free from kerosene and other solvents. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened. Trucks used for hauling asphalt concrete mixtures containing "Rosphalt 50" additive shall have heated bodies and a suitable cover, securely fastened, to protect the mixture from adverse weather.

2. Load trucks using a minimum of three drops. The first load shall be approximately 40% of the total weight of the mix to be hauled and shall be loaded into the center of the front half of the truck. The truck shall then be pulled forward so that the next 40 percent or so of the total load can be deposited into the center of the back half of the bed, near the tailgate. The vehicle shall then be moved backward so that the remaining 20 percent of the mix can be dropped into the center of the bed, between the first two piles.

3. Deliveries shall be scheduled so that placing and compacting of mixture is uniform without stopping and starting of the paver. Hauling over freshly placed material will not be permitted until the material has been compacted, as specified herein, and allowed to cool to ambient temperature.

4. Spread evenly, screed and finish each course to tolerances and requirements specified in this Section.

5. Asphalt concrete pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of asphalt concrete which will meet the specified thickness, smoothness and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

   The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.

6. An automatic screed control system shall be used which is capable of automatically maintaining the specified screed elevation and transverse slope. The control system shall be automatically actuated from a reference system by a sensor.

   The control system shall be capable of working in conjunction with any of the following reference systems:

   a. Ski-type device 40 to 60 feet in length.

   b. Taut stringline (wire) set to grade.

c. Laser beam set to grade.

7. Before commencing each day's paving, clean the paver of any material left from previous paving operations.

8. Place asphalt concrete paving in minimum 10-foot wide strips, except the last strip, which may be a lesser width if necessary.

9. Begin along high sides of areas and proceed towards low side of areas with a one directional slope. Start on centerline and work both ways for crowned pavements.

10. The longitudinal joint in one lift shall offset the longitudinal joint in the lift immediately below by at least 1 foot; however, the longitudinal joint in the surface lift shall be at the centerline of the pavement. Transverse joints in one lift shall be offset by at least 10 feet from transverse joints in the previous lift. Within the same lift, transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

11. When starting paving operations at transverse joints, provide four starting block strips under full length of paver screed. Blocks shall be of a thickness appropriate for the lift being placed.

12. The paver's hopper shall be kept half full throughout the paving day. The wings shall not be emptied until the end of the paving day. Residual material shall be disposed of off Authority property.

13. No raked asphalt concrete material shall be broadcast back onto the pavement mat. Raked material shall be placed back in the paver hopper or disposed of.

14. Use hand placing and finishing methods, as approved by the Engineer, in small areas where use of power equipment is impractical. Lutes shall be used for hand spreading.

15. After density requirements have been meet, and a minimum of one hour after completion of rolling, reduce mat temperature by the controlled application of water, as directed by the Engineer. Allow the compacted mat to cool to 140 degrees F before opening to vehicular traffic.

C. Grade Control

1. Remove grade stakes just prior to rolling of the plant mix macadam base course.

2. The Engineer will provide benchmarks and alignment controls adjacent to each area of construction, which shall be checked and maintained by the Contractor.

3. Perform Contractor's quality control surveys immediately after top course has been rolled to check final surface grades, in accordance with 1.04 D.8.

4. Establish and maintain required lines and grades, including crown and cross slope, for each course during paving operations.

5. Use only qualified surveyors licensed in the State in which Work is being performed.

D. Compaction Equipment

1. Use power rollers weighing not less than 10 tons, having wheel loads of at least 250 lbs./linear inch of combined static and dynamic force and equipped with adjustable scrapers to keep wheel surfaces clean and with efficient means of keeping them wet to prevent the mixture from sticking to the roller.

2. Use types and quantities of equipment as necessary to meet all quality and production requirements of this Section.

3. Do not use steel rollers with pits, flat spots or grooves worn into rolling surface. Roller shall be capable of reversing without backlash.

4. Keep roller on asphalt concrete to avoid contamination of pavement with foreign material.

E. Rolling

1. Commence as soon as material will sustain roller without undue displacement, cracking or shoving.

2. The speed of the roller shall at all times be sufficiently slow to avoid displacement of the hot mixture and to be effective in compaction. Immediately correct any displacement occurring as a result of reversing the direction of the roller, or from any other cause.

3. The sequence of rolling operations shall be at the discretion of the Contractor.

4. Perform rolling with types and quantity of rollers as may be necessary to satisfy all of the pavement quality requirements specified herein.

5. Do not re-roll cold in-place asphalt concrete with a steel wheel or vibratory roller to attempt to increase density. A pneumatic tire roller may be used, subject to approval by the Engineer.

6. At end of each day's operations or when paving is interrupted sufficiently to allow mixture to cool, make a stop by means of tapering the course and form a transverse joint.

7. When resuming operations, cut back joint to expose a granular surface for full depth of the course, paint exposed edge with tack coat, place fresh mixture against joint, tamp and roll.

8. Any pavement that becomes loose and broken or mixed with dirt, develops check-cracking, or is in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at no cost to the Authority. Skin patching will not be allowed.

9. For asphalt concrete mixes containing "Rosphalt 50", breakdown rolling shall begin immediately after laydown and finish rolling shall be performed when the mix temperature is between 210 degrees F and 140 degrees F.

F. Joints

1. Form all joints in such a manner as to ensure a continuous bond between the courses and to obtain the required density, as demonstrated, tested and approved in the control strip. All joints shall have the same texture as other sections of the course and shall meet the requirements for density, smoothness and grade. Minimize raking of joints. Any mix raked from joint shall be discarded and not broadcast back onto the mat.

2. For transverse joints, the roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a temporary stop. After a temporary stop and prior to the continuation of paving, the tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face before placing the adjacent lane. Apply tack coat on all newly exposed contact surfaces before placing any fresh mixture against the joint.

3.03 CORRECTIONS OF DEFICIENCIES

A. Deficiencies in Surface Smoothness

1. Make corrections as specified below at no cost to the Authority in the event of the following:

   a. Longitudinal Smoothness for roadways where paving lane lengths equal or exceed 500 linear feet.

      (1) The Profile Index exceeds 22.0 inches per mile, or the surface profile deviations exceed 0.4 inches in 25 feet, when tested in accordance with 1.04 E.10.a, unless the Engineer elects to accept the deficient surface subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 H and I.

   b. Longitudinal and transverse direction for parking lots and port container storage areas.

      (1) In areas that do not adequately drain the water from the surface, or that otherwise hold water.

   c. Longitudinal direction for roadways where paving lane length is less than 500 feet.

      (1) 15 percent of all measurements in a paving lane exceed the requirements of 1.03 D.1.c when tested in accordance with 1.04 E.10.b.

      (2) Any deviations exceeding 1/4 inch when tested with a 10-foot straightedge.

2. The area of deficiencies in surface smoothness and/or surface grade tolerance is defined as the area of the lot defined in 1.04 E.10.a.(3), b.(1), except for parking lots and port container storage areas where the area of deficiencies will be determined by the Engineer based on the results of the test specified in 1.04 E.10.c.

3. Remove and replace, or diamond grind, pavement deficient in surface smoothness, in accordance with all applicable requirements of the Contract Drawings and this Section, at times approved by the Engineer, so as not to interfere with operations of the Authority or others using the area.

4. Remove and replace shall mean milling a minimum depth of twice the nominal maximum aggregate size of the asphalt concrete and repaving to the finished grade shown on the Contract Drawings with the same type asphalt concrete mix as removed. Remove existing pavement as necessary to provide square joints for the full depth of the overlay.

5. Diamond grinding may be used to correct deficiencies in surface smoothness and surface grade tolerance subject to approval by the Engineer. However, if removal of more than 3/4 inch of pavement is required to correct any deficiency, the deficient area shall be removed and replaced.

6. Diamond grinding equipment shall be approved by the Engineer and have a minimum grinding head of 36 inches and at least 5 blades per inch of shaft. Diamond grinding shall not be performed when the temperature of the asphalt concrete surface exceeds 80 degrees F. Slurry produced from grinding operations shall be properly disposed of off Authority property.

7. Where corrections are required, the entire width of the paving lane by the length of defective area shall be corrected. In the sole opinion of the Engineer, if the deficiencies are closely spaced and correcting individual areas will adversely affect ride, the entire pavement surface shall be corrected.

8. Following the correction of deficiencies, the Engineer will retest the finished surface of the asphalt concrete. In the event the Profile Index or surface profile deviations exceed the required values, make additional corrections at no cost to the Authority.

B. Deficiencies in In-Place Air Voids of Top and Bottom Courses and Bridge Deck Membrane

1. With the exception of bridge deck membrane, any pavement sublot with in-place mat air voids less than 2.0 percent or greater than 8.0 percent (9.0 percent for bottom course and materials placed on roadway structures) shall be removed and replaced at no additional cost to the Authority. For mixes containing "Rosphalt 50" additive, any pavement sublot with in-place mat air voids greater than 6.0 shall be removed and replaced at no additional cost to the Authority. For paving lifts other than the top lift of asphalt concrete, the Engineer may elect to accept deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

2. For bridge deck membrane, any pavement sublot found to be below the lower density limit as specified in 1.03 D.2.a or having air voids greater than 2.0 percent shall be removed and replaced at no additional cost to the Authority.

C. Deficiencies in Marshall Stability and Flow

In accordance with 1.03 C.2 for stability and flow, if the Percentage of Material Within Tolerance Limits (PWL) of a lot for either parameter as set forth in 4.03 B.5 equals or exceeds 90 percent, the lot will be acceptable. If the PWL for either parameter is less than 90 percent, determine the reason and take corrective action immediately. If the PWL is below 80 percent for either parameter, stop production and make adjustments to the mix.

D. Deficiency in Final Surface Grade

1. When more than 15 percent of all measurements within a lot exceed the grade tolerance, measured in accordance with 1.04 E.11, remove and replace or diamond grind the entire lot in accordance with 3.03 A, unless the Engineer elects to accept the deficient surface, subject to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 H and I.

2. When any individual measurement exceeds a grade tolerance of plus or minus 0.06 foot, remove and replace the surface of the area exceeding the tolerance in accordance with 3.03 A.

3. Following the correction of deficiencies, the Engineer will retest the final surface of the asphalt concrete. In the event grade tolerance is exceeded, make additional corrections at no cost to the Authority.

E. Deficiencies in the Performance Grade Requirements of Modified Asphalt

Remove and replace the deficient material on a lot basis, unless the Engineer elects to accept the deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

F. Deficiencies for Tensile Strength Ratio (TSR)

Remove and replace the deficient material on a lot basis if the TSR is less than or equal to 60 percent , unless the Engineer elects to accept the deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Where the Contract requires less than 500 tons of asphalt concrete, no adjustments to Contract compensation will be made as specified herein.

B. Where the Contract requires 500 tons or more of asphalt concrete, adjustments to Contract compensation will be made as specified in 4.03 A, B, C, D, E and F.

C. Notwithstanding other adjustments to Contract compensation or corrections specified herein for various deficiencies, no payment will be made for material placed above the allowable tolerance above required grade as specified in 1.03 D.4, or for material that must be removed to correct deficiencies, or for that material placed in excess of the plus tolerance for the total thickness of each course as specified in 1.03 D.3.

D. The computations for adjustments to Contract compensation may require conversion between tons and square yards. Such conversion will be made using the actual computed weight per square yard per inch of thickness determined from the lot's average bulk specific gravity for each type of course times the density of water at 70 degrees F.

E. Adjustments to Contract compensation for in-place mat densities, in-place joint densities for surface course and Marshall air voids shall be determined by applying percentages, calculated as specified in 4.03 B, to the assigned unit price of Sixty Dollars ($60.00) or One Hundred Sixty Dollars ($160.00) for mixes containing "Rosphalt 50", per ton of asphalt concrete; or in the case of Classified Work, by applying such percentages to the actual Contract Unit Price bid for the appropriate asphalt concrete item in the Schedule of Unit Prices for Classified Work, but in no case less than Sixty Dollars ($60.00) or One Hundred Sixty Dollars ($160.00) for mixes containing "Rosphalt 50", per ton of asphalt concrete.

F. The percentage adjustment to the unit price specified in 4.01 E for Marshall air voids, mat density and joint density of the surface course shall be as follows, except as set forth in 4.01 G:

1. When all values calculated in accordance with 4.03 B are 100 percent or greater, the highest value will be used to adjust Contract compensation.
2. When all values calculated in accordance with 4.03 B are less than 100 percent, the lowest value will be used to adjust Contract compensation.
3. When values calculated in accordance with 4.03 B are both greater and less than 100 percent, the product of the highest and lowest values will be used to adjust Contract compensation.

G. When the Engineer elects to adjust Contract compensation in lieu of removal and replacement of material with deficient in-place mat air voids, tensile strength ratio or deficiencies in modified asphalt performance grade, the percentage adjustment to the unit price specified in 4.01 E will be set at 50 percent. No further adjustment will be made for Marshall air voids, mat density or joint density of the surface course.

H. Adjustments for surface smoothness and final surface grade will be based on the final test results, which will be measured after the correction of deficiencies. Reductions in payment will be determined by the following:

$R = A \times D \times F \times T \times 0.00646$

Where:

R = Reduction in payment per lot for surface smoothness or final surface grade, dollars

T = Thickness of final pavement lift, inches

A = Area of lot, square feet

D = Price per ton of asphalt concrete, assigned unit price or contract unit price as set forth in 4.01 E

F = Contract Unit Price Adjustment Factor specified in 4.03 D and 4.03 E

Reductions in payment for failure to meet surface smoothness and final surface grades will be calculated separately for the entire pavement or overlay surface. Deductions from Contract compensation will be made for the requirement (surface smoothness or final surface grade) which results in the greatest payment reduction. Reductions for surface smoothness or final surface grade will be in addition to all other adjustments to Contract compensation.

I. When the Engineer elects to adjust Contract compensation in lieu of correcting areas with deficiencies in surface smoothness or final surface grade, the Contract Unit Price Adjustment Factor specified in 4.01 H will set at 0.10 for surface smoothness and 0.25 for final surface grade.

4.02 ADJUSTMENT TO CONTRACT COMPENSATION FOR THICKNESS DEFICIENCY IN PLANT MIX MACADAM BASE COURSE

A. Where the deficiency of a plant mix macadam base course core exceeds the allowable minus tolerance in plant mix macadam base course thickness, one additional core will be taken by the Engineer in each of the other three sublots adjacent to the core taken in accordance with 1.04 E.4. Plant mix thickness for the area of entire lot will be the average of the four cores.[4] Where there is a deficiency in the average of the four cores in excess of the allowable minus tolerance, the total thickness of succeeding courses in the area of entire lot shall be increased by the amount the deficiency exceeds the allowable tolerance.

B. For each additional lot resampled in accordance with 4.02 A above, there will be deducted from the Contract compensation, in addition to adjustments for deficiencies as hereinafter specified, an amount of One Thousand Dollars ($1,000.00).

4.03 ADJUSTMENT TO CONTRACT COMPENSATION FOR DEFICIENCIES IN TOP AND BOTTOM COURSES AND BRIDGE DECK MEMBRANE

A. Deficiency in Thickness

Thickness of each course, excluding overlay, will be the average of the four cores in the lot for each course[5]. Deductions from Contract compensation for deficiencies in thickness of top course or total of top and bottom courses, modified as may be required by 4.02 A, will be the following amounts (deducted per square yard) for the entire area lot:

Amount of Minus Deficiency (inches)	Amount of Payment Deduction (Dollars per Square Yard)
Greater than 1/4 and up to 1/2	1.00
Greater than 1/2 and up to 3/4	2.00

For minus deficiencies in excess of 3/4 inch either in average of four cores or in any individual core, at the Engineer's option, remove and replace deficient pavement or place an overlay that will satisfy all requirements of this Section.

B. Deficiency in In-Place Mat Density, In-Place Joint Density and Marshall Air Voids

1. Top and bottom courses will be approved on a lot basis with each lot coinciding with that defined in 1.04 D.1.a.

2. Density

a. In-place mat density specified in 1.03 D.2.a will be evaluated for Section compliance using the average of the random sublot in-place density determinations from cores of the area covered by the lot specified in 1.04 D.1.a.

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4 In determining average thickness, if any core exceeds required thickness by more than 1/2 inch, the thickness of that core will be assumed to be 1/2 inch in excess of required thickness.

5 In determining average thickness, if any core exceeds required thickness by more than 1/4 inch, the thickness of that core will be assumed to be 1/4 inch in excess of required thickness.

b. In-place joint density specified in 1.03 D.2.b will be evaluated for Section compliance using the average of random sublot in place joint density determinations from cores of the area covered by the lot specified in 1.04 D.1.a.

3. Marshall air voids will be evaluated for Section compliance using the average of the random sublot void determinations from hot mix samples from the lot specified in 1.04 D.1.a.

4. The Engineer will check each lot for in-place mat densities, in-place joint densities for surface courses only, and Marshall air voids with adjustments to Contract compensation based on the Percentage of Material Within Tolerance Limits (PWL) as determined by 4.03 B.5 below and by the "Table For Estimating Percent of Lot Within Tolerance Limits-PWL (Standard Deviation Method)". No deficient lot will be approved without an adjustment to Contract compensation made in accordance with the tables entitled "Adjustment to Contract Compensation For In-Place Mat Density and Marshall Air Voids" and "Adjustment to Contract Compensation for In-Place Joint Density".

5. Method of Estimating Percentage of Material Within Tolerance Limits (PWL)

a. Locate sampling positions on the lot by use of random sampling procedures specified in FAA ERLPM, Section 6.

b. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with 1.04 D and E.

c. Determine the average value of all samples ($\overline{X}$).

d. Find the standard deviation (Sn) by use of the following formula:

$$S_n = \sqrt{d_1^2 + d_2^2 + d_3^2 + \ldots + d_n^2/n-1}$$

Where

S_n = standard deviation of the number in the set

$d_1, d_2,$ = deviation of the individual sample values $X_1, X_2, \ldots$ from the average value that is,

d_1 = $(X_1 - \overline{X})$, $d_2 = (X_2 - \overline{X})$, $d_n = (X_n - \overline{X})$

n = number of sublots

e. Find the Lower Quality Index (QL) by subtracting the lower tolerance limit (L) from the average values ($\overline{X}$) and dividing the result by standard deviation (Sn).

$$Q_L = \frac{\overline{X} - L}{S_n}$$

f. Find the Upper Quality Index (QU) by subtracting the average value ($\overline{X}$) from the upper tolerance limit (U) and dividing the result by standard deviation (Sn).

$$Q_U = \frac{U - \overline{X}}{S_n}$$

g. The percentage of material above lower tolerance limit (PL) and the percentage of material below upper tolerance limit (PU) will be found by entering the "Table For Estimating Percent of Lot Within Tolerance Limits - PWL (Standard Deviation Method)" with QL and QU, using the column appropriate to the total number (n) of sublots and reading the number under the column headed "Percent Within Tolerance Limits (PWL)". If the values fall between values shown on the table, use the next higher value for PL or PU.

h. For asphalt concrete properties with only a lower tolerance limit (stability, mat density, joint density), the Percentage of Material Within Tolerance Limits (PWL) equals PL. For asphalt properties with upper and lower tolerance limits (air voids and flow) determine PWL using the following formula:

$$PWL = (P_U + P_L) - 100$$

i. If the tests within a lot include a very large or a very small value which appears to be outside the limits of variation, the Engineer will check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value will be discarded when computing Percentage of Material Within Tolerance Limits (PWL).

C. Adjustment to Contract compensation for each lot will be made in accordance with the formula contained in the table entitled "Adjustment to Contract Compensation For In-Place Mat Density and Marshall Air Voids" by entering the appropriate row with the value of PWL and performing the calculation indicated for that PWL to determine the percentage adjustment of the unit price (specified in 4.01).

ADJUSTMENT TO CONTRACT COMPENSATION FOR IN-PLACE MAT DENSITY AND MARSHALL AIR VOIDS	
Percentage of Material Within Tolerance Limits (PWL)	Percentage Adjustment of the Unit Price (specified in 4.01 E and 4.01 F)
96-100	106
90-96	PWL + 10
80-90	0.5 (PWL) + 55
65-80	2.0 (PWL) – 65
Below 65	[6]

[6] The lot shall be removed and replaced to meet Section requirements as ordered by the Engineer. In lieu thereof, and subject to the provisions in 3.03 B for mandatory removal and replacement, the Contractor and the Engineer may agree in writing that, for purposes of practicality, the deficient lot shall not be removed and adjustment to Contract compensation shall be made at 75 percent of the unit price specified in 4.01 E.

D. Deficiency in Final Surface Grade Tolerance

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Exceeding Final Surface Grade Tolerance" by entering the appropriate row with the percentage of all measurements within a lot which exceed the grade tolerance, measured in accordance with 1.04 E.11, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR EXCEEDING FINAL SURFACE GRADE TOLERANCE	
Measurements Exceeding Grade Tolerance (Percent)	Contract Unit Price Adjustment Factor
0.0 – 5.0	0.00
5.1 – 10.0	0.05
10.1 – 15.0	0.25
15.1 and up	Corrective work required as specified in 3.03 D

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 H.

E. Deficiency in Surface Smoothness

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Surface Smoothness", by entering the appropriate row with the Profile Index, measured and calculated in accordance with 1.04 E.10, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR SURFACE SMOOTHNESS	
Average Profile Index (inches per mile)	Contract Unit Price Adjustment Factor
0.0 - 15.0	0.00
15.1 - 16.0	0.02
16.1 - 17.0	0.04
17.1 - 18.0	0.06
18.1 - 20.0	0.08
20.1 - 22.0	0.10
22.1 and up	Corrective work required as specified in 3.03 A

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 H.

F. Adjustment to Contract compensation for each lot will be made in accordance with the formula contained in the table entitled "Adjustment to Contract Compensation for In-Place Joint Density" by entering the appropriate row with the value of PWL and by performing the calculation indicated for that PWL to determine the percentage adjustment of the unit price (specified in 4.01 E.).

ADJUSTMENT TO CONTRACT COMPENSATION FOR IN-PLACE JOINT DENSITY	
Percentage of Material Within Tolerance Limits (PWL)	Percentage Adjustment of the Unit Price (specified in 4.01 E and 4.01 F)
96 – 100	106
90 – 96	PWL + 10
80 – 90	0.25 x PWL + 77.5
65 – 80	PWL + 17.5
Below 65	[7]

[7] The lot shall be removed and replaced to meet Section requirements as ordered by the Engineer. In lieu thereof, and subject to the provisions in 3.03 B for mandatory removal and replacement, the Contractor and the Engineer may agree in writing that, for purposes of practicality, the deficient lot shall not be removed and adjustment to Contract compensation shall be made at 75 percent of the unit price specified in 4.01 E.

TABLE FOR ESTIMATING PERCENT OF LOT WITHIN TOLERANCE LIMITS - PWL (STANDARD DEVIATION METHOD)

Percent Within Tolerance Limits (PWL)	Positive Values of Q_L or Q_U n = Number of Sublots					
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4716
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630
87	1.0597	1.1100	1.1173	1.1191	1.1199	1.1204
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015
83	0.9939	0.9900	0.9785	0.9715	0.9672	0.9643
82	0.9749	0.9600	0.9452	0.9367	0.9325	0.9281
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958

TABLE FOR ESTIMATING PERCENT OF LOT WITHIN TOLERANCE LIMITS - PWL (STANDARD DEVIATION METHOD)

Percent Within Tolerance Limits (PWL)	Positive Values of Q_L or Q_U n = Number of Sublots					
	n = 3	n = 4	n = 5	N = 6	n = 7	n = 8
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747
70	0.6787	0.6000	0.5719	0.5583	0.5504	0.5454
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592
66	0.5563	0.4800	0.4545	0.4424	0.4354	0.4310
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4031
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855
56	0.2164	0.1800	0.1688	0.1636	0.1613	0.1592
55	0.1806	0.1500	0.1408	0.1363	0.1338	0.1322
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0792
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264
50	0.0	0.0	0.0	0.0	0.0	0.0

G. Additional Tests

1. In the event the Contractor elects to question the original density test results obtained from a particular lot for either the mat density or joint density, the Contractor may request additional testing of that lot in writing within 48 hours of receipt of the written test results from the Engineer. Upon written request received from the Contractor for such additional testing, the Engineer will test one additional sample from each sublot from randomly selected locations in the pavement where the lot was placed. The redefined test will consist of the Engineer's original samples and the additional Contractor's requested samples. The "Percent of Material Within Tolerance Limits-PWL" will be determined in accordance with 4.03 B.5. The value will be used to determine any adjustment to Contract compensation. Only one resampling per lot will be permitted.

2. Additional tests requested by the Contractor shall be paid for by the Contractor to the Authority at the rate of One Thousand Dollars ($1,000) per lot tested.

4.04 ADJUSTMENT TO CONTRACT COMPENSATION FOR CHANGES IN THE INDEX PRICE OF ASPHALT CEMENT

A. General

An adjustment to Contract compensation will be made for changes in the index price of the asphalt cement in asphalt concrete and plant mix macadam base and for tack coat, as set forth in 4.04 C, provided that the Contract requires a total of 500 tons or more of asphalt concrete and plant mix macadam base course.

B. Engineer's Method of Measurement

1. Asphalt concrete including top course and bottom course and plant mix macadam base course will be measured by the ton. The weight will be determined by one of the following methods:

a. A weigh ticket printed by an automatic printer system used in conjunction with an automated batching and mixing system. The printed ticket shall show the date, the individual weights of the various components of the asphalt concrete or plant mix macadam base course mixture in a batch, the total weight of each batch and the sum of the all batch weights in the truckload. At the completion of each day's work, a producer's representative shall certify in writing that the total weight supplied was correct.

b. A weigh ticket printed by an automatic scale showing the tare and gross weights of the truck as determined for each trip and the time and date indicating when the empty truck was tarred and when the loaded truck departed from the plant. Time and date may be printed automatically by a time clock. However, the net weight must be documented on each delivery ticket by a State certified weigh master.

c. In the event of a breakdown of an automatic printer system, weigh tickets showing the gross, tare and net weight of each truck, as entered and certified by a weigh master, will be accepted for a period not exceeding the necessary repair time as certified by a State licensed repairman.

A weigh ticket shall be furnished for each truckload. Material will not be accepted unless accompanied by a weigh ticket, which shall be legible and clearly indicate the printed heading of the supplier and location of the batch plant, the title of the Contract for which delivery is intended, the time and date, truck number, lot number and mix number of material being furnished and the total net weight in each truckload.

2. Tack coat will be measured by the gallon at a temperature of 285 degrees F.

C. Asphalt Price Adjustment

1. The asphalt price adjustment for the asphalt cement in asphalt concrete or plant mix macadam base course will be determined monthly using the following formula:

$$Ac = (A - BA) \times T$$

Where Ac = Asphalt Cement Price Adjustment, in dollars
A = Asphalt Cement Price Index[8], in dollars per ton
BA = Basic Asphalt Cement Price Index[9], in dollars per ton
T = Tons of New Asphalt Cement[10]

2. The asphalt price adjustment for tack coat will be determined on a monthly basis using the following formula:

$$At = (A - BA) \times (C) \times (G) \times 0.003986$$

Where At = Asphalt Cement Price Adjustment for tack coat, in dollars
C = Petroleum Content of the Tack Coat in Percent by Volume: Use 1.0 for asphalt cement and cutbacks
A = Asphalt Cement Price Index[8], in dollars per ton
G = Tack Coat Furnished in Gallons and Applied at 285°F, where one gallon is equal to 0.003986 ton
BA = Basic Asphalt Cement Price Index[9], in dollars per ton

3. Should a monthly Asphalt Cement Price Index increase 50 percent or more over the Basic Asphalt Cement Price Index, no additional asphalt concrete, or plant mix macadam base shall be furnished for the Contract without written approval from the Engineer.

4. Should a monthly Asphalt Price Index decrease from the Basic Asphalt Price Index, payments will be decreased accordingly.

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8 The Asphalt Cement Price Index is the price in dollars per ton (English Units), published by the New Jersey Department of Transportation for the area North of Route 195, for the month during which the asphalt concrete paving or tack coat application occurred.

9 The Basic Asphalt Cement Price Index is the price in dollars per ton (English Units), published by the New Jersey Department of Transportation, for the area North of Route 195, for the month immediately prior to the month during which bids are received.

10 The weight of asphalt cement eligible for price adjustment including all conventional and modified asphalt concrete and plant mix macadam base course will be determined by multiplying the percentage of new asphalt cement in the approved job mix formula by the weight of asphalt concrete mixture, measured in accordance with 4.04 B.

5. Asphalt price adjustments will not be made in those months for which the Monthly Asphalt Cement Price Index has changed by less than five percent from the Basic Asphalt Cement Price Index.

6. If the Asphalt Cement Price Index is adjusted more than once in a month, the asphalt price adjustment may be made.

END OF SECTION

SECTION 02553

ASPHALT CONCRETE PAVING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

02553C01 Submit certified test data, location of each type aggregate to be used and quantities to be obtained from each location and make arrangements for the Materials Engineering Unit to obtain samples from each such location for checking against the samples submitted. Take all samples in accordance with requirements of ASTM D 75 and ASTM D 242.

02553C02 If requested, submit to the Chief of Materials Engineering, Materials Engineering Unit samples of each type aggregate to be used and from each source with proper identification as to source, type of aggregate and Contract number. Submit in clean, sturdy bags and in the following amounts for each sample when requested:

Reclaimed Asphalt Pavement (when used)	50 lbs.
Coarse Aggregate	25 lbs.
Fine Aggregate	25 lbs.
Mineral Filler	5 lbs.

02553C03 Submit for each type asphalt cement proposed for use to the Chief of Materials Engineering, Materials Engineering Unit the following for approval. Resubmit the data each time asphalt cement from a different source is proposed.
1. The name and location of the supplier(s).
2. An analysis of such asphalts by the supplier, certifying that the results of tests comply with the requirements of AASHTO M320 and this Section.
3. If requested, submit four 1-quart samples of the asphalt cement.

02553C04 Submit for each additive proposed for use to the Chief of Materials Engineering, Materials Engineering Unit, the following for approval:
1. The name and location of the supplier(s).
2. An analysis of such additive by the supplier, certifying the chemical properties and compliance with this Section.
3. If requested, submit a sample of the additive, in the manufacturer's original sealed bag or container.

02553C05 For mixes containing "Rosphalt 50" additive, the manufacturer ,Chase Construction Products/Royston Division of Chase Corporation, may request samples of aggregates,

asphalt cement and/or additives to be submitted to them in their laboratory to develop or verify the Job Mix Formulae.

Manufacturer Test Reports

02553F01 Submit to the Chief of Materials Engineering, Materials Engineering Unit, the name of the supplier and an analysis of the asphalt tack coat to be used on the Contract.

Calculations

02553H01 Submit to the Chief of Materials Engineering , Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey, 07310-1397, for approval, all Job Mix Formulae with Checklist (specified in 2.03 B) for each type of asphalt concrete mix, from each plant and each new source of material at least 10 days prior to the start of production.

02553H02 In lieu of submitting samples of aggregates, asphalt cement and/or additives, the Engineer may verify the Job Mix Formulae at the plant.

Quality Assurance-Quality Control

02553L01 Submit quality control plan and control charts to the Chief of Materials Engineering, Materials Engineering Unit, for approval, at least 5 days prior to the start of production.

END OF APPENDIX "A"

DIVISION 2

SECTION 02574

ABRASIVE BLASTING OF PAVEMENTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for abrasive blasting of the following pavement items:

A. Existing concrete to which new concrete is to be bonded.

B. Concrete surfaces to which waterproofing, coatings and other finishes are to be applied

C. Steel surfaces, including corroded reinforcement, to which concrete or joint material is to be applied

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

Steel Structures Painting Council (SSPC)

SP6 Commercial Blast Cleaning

1.03 JOB CONDITIONS

A. Do not conduct abrasive blasting operations if U.S. Weather Bureau forecasts precipitation within the 24-hour period following proposed operations.

B. Do not conduct abrasive blasting operations unless the application of new materials is to follow the abrasive blasting within the same work period.

PART 2. PRODUCTS

2.01 MATERIALS

Abrasive grit shall be "Black Beauty" as manufactured by Reed Minerals, a division of Harsco Corp., South Kearny, NJ, or approved equal.

PART 3. EXECUTION

3.01 PREPARATION

A. Clear surfaces to be abrasive blasted of equipment and debris.

B. Erect curtains or temporary partitions or otherwise protect work area to safeguard persons, traffic, adjacent structures, properties, waterbodies, and vehicles from abrasive blasting operations and prevent excessive airborne debris, all to the satisfaction of the Engineer.

3.02 ABRASIVE BLASTING

A. Abrasive grit nozzle blasting equipment shall be the following, or approved equal:

1. "Clemco" manufactured by Clementina, Oakland, CA;
2. "Pauli and Griffin" manufactured by Pauli Griffin, Vacaville, CA;
3. "Sandstorm" manufactured by Bowen Tools, Inc., Houston, TX.

B. Where relatively smooth, horizontal concrete surfaces require abrasive blasting, whether in enclosed areas or elsewhere, and where dust would be a problem, use the self-contained steel shot system in lieu of abrasive grit blasting.

Self-contained steel shot blasting equipment shall be the following, or approved equal:

1. "Blastrac" manufactured by Wheelabrator-Frye, Mishawaka, Indiana;
2. "Portable Power Blast Equipment" manufactured by Goff Corporation, Seminole, Oklahoma.

C. Abrasive blast surfaces of concrete or steel to remove all dirt, grease, oil, asphalt, rubber, laitance formed on concrete, curing compounds, and all other deleterious material.

D. For concrete surfaces, remove a thin layer of mortar to expose the aggregate.

E. For steel surfaces, abrasive blast in conformance with SSPC-SP6, except where stricter requirements are specified elsewhere in the Specifications or shown on the Contract Drawings.

F. Clean blasted surfaces of dust and loose residue, and properly dispose of same away from Authority property

END OF SECTION

DIVISION 2

SECTION 02575

PAVEMENT MILLING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the removal of asphalt concrete and Portland cement concrete pavement by milling.

1.02 JOB CONDITIONS

To minimize work interruptions, make provisions to ensure that spare parts for removal equipment and a qualified mechanic are available from a local distributor of the equipment.

PART 2. PRODUCTS

(None Required)

PART 3. EXECUTION

3.01 PAVEMENT REMOVAL

A. Equipment

1. Milling equipment shall be a self-propelled planing, grinding or cutting machine, with variable operating speeds and automatic grade controls, capable of removing asphalt and concrete pavement without the use of heat.
2. Front-end loader excavating equipment shall be used.
3. Pneumatic hammers shall not be heavier than nominal 30-pound class when used on bridge decks.

B. In the removal of pavement, do not deposit any material in catch basins, or on existing construction that is to remain in place. Any material so deposited shall be promptly removed.

C. Do not damage or disturb any adjacent pavements, joint structures or existing construction that are to remain in place. Should such damage occur due to the Contractor's operations, repairs shall be immediately made to the satisfaction of the Engineer.

D. Sawcut existing pavement to the required depths and horizontal limits of removal areas shown on the Contract Drawings. Sawcutting may be eliminated if, in the opinion of the Engineer, mechanical removal equipment results in a satisfactory straight vertical edge of pavement. However, sawcutting shall not be eliminated in areas shown as "Sawcut" on the Contract Drawings.

E. Remove existing pavement to the limits and depths shown on the Contract Drawings.

F. For removal of pavement along curves or other tight areas not accessible to the milling machine, or for removal of deteriorated concrete, use pneumatic hammers or mechanical chippers. On bridge decks, equipment shall not be operated at an angle exceeding 45 degrees relative to the pavement surface.

G. Where milled pavement is not required to be overlayed, milling shall be accomplished by coordinating machine and drum speeds of operation so as to produce a surface to permit passage of traffic at posted speed limit without impaired directional control. Surface shall be free from gouges, continuous grooves, ridges and delaminated areas and shall have a uniformly textured appearance consisting of discontinuous longitudinal striations.

H. Where milled areas are required to be reopened to traffic prior to overlaying, ramp the perimeter of the milled area and around roadway castings and similar appurtenances if they become exposed, to provide smooth, safe transition for traffic between milled and unmilled surfaces.

I. Remove all debris resulting from removal operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer.

Use hand brooms, mechanical sweepers or vacuum equipment for cleanup immediately before the end of each work period.

Dispose of material resulting from removal operations away from Authority property unless otherwise shown on the Contract Drawings.

END OF SECTION

DIVISION 2

SECTION 02578

PAVEMENT JOINT SEALING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for sealing joints in pavements, sidewalks and curbs located on grade.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM D 3405	Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements
	Federal Specifications
SS-S-1401	Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements
SS-S-200	Two Component Joint Sealant, Jet Fuel Resistant, Cold Applied for Portland Cement Concrete Pavement

1.03 ENVIRONMENTAL REQUIREMENTS

A. Do not apply any sealant during rain conditions.

B. Do not apply silicone sealant when ambient or pavement temperature is 40 degrees F, or below.

C. Do not apply rubberized asphalt sealant when ambient or pavement temperature is 50 degrees F, or below.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver silicone sealant to the construction site in unopened containers with the manufacturer's lot numbers clearly marked on the containers. Include with the delivery a manufacturer's invoice stating the date(s) of shipment and lot numbers of the silicone sealant to be used.

B. Store silicone sealant at ambient temperatures at or below 90 degrees F.

C. Silicone sealant which has been in storage more than six months shall not be used in the construction and shall be removed from the construction site immediately.

1.05 SUBMITTALS

See Appendix "A" for Submittal requirements

PART 2. PRODUCTS

2.01 MATERIALS

A. Rubberized Asphalt Joint Sealant shall be one of the following and no substitution will be permitted.

1. Road Saver 211 - manufactured by Crafco Inc. Chandler, AZ
2. Hi-Spec - manufactured by W. R. Meadows, Elgin, IL
3. Koch 9005 - manufactured by Koch Materials Company, Pensauken, NJ

B. Silicone Sealant

1. For Concrete Pavement, Sidewalk and Curb Joints
   a. "Dow Corning 888", manufactured by Dow Corning Corp., Midland, MI; or approved equal meeting ASTM D 3405 and Federal Specification SS-S-200.
2. For Asphalt Pavement in Aircraft Apron and Fueling Areas
   a. "Dow Corning 890", manufactured by Dow Corning Corp., Midland, MI; or approved equal meeting ASTM D 3405 and Federal Specification SS-S-1401.

C. Backer Rod - closed cell, expanded polyethylene foam rod, manufactured by A.H. Harris, New Britain, CT; or approved equal.

PART 3. EXECUTION

3.01 PREPARATION

A. Removal and Cleaning Equipment

1. Mechanical joint router shall be "Jiffy" Crack and Joint Router, manufactured by Aeroil Products Co., Inc., South Hackensack, NJ; or approved equal.
2. Air compressor shall be capable of furnishing not less than 100 cubic feet of air per minute at a pressure of not less than 100 pounds per square inch. Compressed air shall be free of oil and moisture.
3. Power driven concrete saw shall be "Compact Concrete and Asphalt Saw" manufactured by Cimline, Inc., Minneapolis, MN; or approved equal.

B. Removal of Existing Joint Material

1. For existing asphalt concrete and Portland cement concrete pavement joints, use a mechanical joint router to remove any joint sealing material present and to reface or modify existing joints to the dimensions shown on the Contract Drawings.

2. For new asphalt concrete pavement joints, use a mechanical joint router or power-driven concrete saw to cut joints to the dimensions shown on the Contract Drawings.

3. For newly sawed Portland cement concrete joints, after a minimum of 72 hours has passed from the completion of concrete placing operations, use a mechanical joint router or power-driven concrete saw to widen sawed joints to their final required dimensions shown on the Contract Drawings.

4. No removals are required for formed joints.

5. During removal and cleaning operations, do not damage any premolded joint filler that is to remain in expansion joints.

C. Cleaning Joints

1. General

   a. Pavement joints shall be cleaned of any routing or cutting debris, and made free of any particles or film of old sealant.

   b. Abrasive blasting operations shall be performed in accordance with requirements specified in the Section entitled "ABRASIVE BLASTING".

2. Asphalt Concrete Pavement Joints (New and Existing)

   Clean joint slots with power-driven wire brush followed by an oil-free compressed air jet.

3. Existing Portland Cement Concrete Pavement Joints

   Clean joint slots with a power-driven wire brush, followed by an abrasive blast, followed by an oil-free compressed air jet.

4. New Portland Cement Concrete Pavement Joints (Sawed or Formed)

   Clean joint slots with an abrasive blast. Follow by an oil-free compressed air jet.

3.02 SEALANT APPLICATION

A. Application Equipment

1. Double Boiler Indirect-Fired Kettle/Rubberized Asphalt Sealant Applicator

   The space between the inner and outer shells of a double boiler indirect-fired kettle shall be filled with suitable heat transfer oil having a flash point of not less than 550 degrees F. The kettle shall be equipped with satisfactory means of agitating the sealant at all times without excessive incorporation of air. The kettle shall be equipped with thermostatic control for automatic regulation of the temperature of the oil bath and sealant and shall have a recording thermometer for recording the temperature of the sealant. A hose shall be directly connected to the melting kettle in such a manner as to permit pumping the melted sealant through the hose to a shoe-type applicator that shall direct and control the filling of the joints. The hose and applicator shall be insulated.

2. Compressed Air-Driven Extrusion Pump/Silicone Sealant Applicator

   a. The applicator shall be one of the following, or approved equal:

      (1) "700 Series Teflon Packed Pumping System" with teflon lined hoses, manufactured by Pyles Industries, Inc., Wixom, MI

      (2) "King" or "Bulldog" Model pumping systems with teflon lined hoses, manufactured by Graco., Inc., Minneapolis, MN

   b. The silicone sealant applicator nozzle shall be shaped to fit inside the joint to introduce the sealant between the joint faces.

B. Rubberized Asphalt Sealant Installation

1. Use rubberized asphalt sealant for sealing joints in asphalt concrete pavement and joints between asphalt concrete pavement and Portland cement concrete pavement and curbs.

2. Seal joints immediately following, and during the same work period as, the cleaning operation.

3. Rubberized asphalt sealant shall be heated using a double boiler indirect-fired kettle/applicator. Apply the sealant to cleaned joints at the manufacturer's recommended application temperature.

4. At the start of each day's sealing operations, one gallon of heated sealant shall be flushed through the applicator into a one-gallon container and disposed of away from Port Authority property.

5. Apply sealant as shown on the Contract Drawings in such a manner that the in-place sealant shall be well bonded to the pavement and be free of voids or entrapped air. Seal the joints so that upon completion of the work, the surface of the sealant material shall be 1/4 inch, plus or minus 1/8 inch, below the adjacent pavement surface. Refill or "spot up" all low areas before final approval. Remove excess material on the surface of the pavement and leave the pavement surface in a clean condition. The period of cure shall be in accordance with the manufacturer's recommendations. Vehicular or heavy equipment traffic shall not be permitted on the pavement in the area of the joints during the curing period.

C. Silicone Sealant Installation

1. Silicone sealant shall be used to seal Portland cement concrete pavement, sidewalks, curb joints and asphalt concrete pavements in aircraft aprons and fueling areas.

2. Seal joints immediately following, and during the same work period as, the cleaning operation.

3. Install backer rods without stretching and as shown on the Contract Drawings.

4. Apply silicone joint sealant to cleaned joints using a compressed air driven extrusion pump/silicone sealant applicator.

5. Apply sealant as shown on the Contract Drawings in such a manner that the in-place sealant will adhere to the concrete and be free of voids. Seal the joints so that material shall be 1/4 inch, plus or minus 1/8 inch, below the pavement surface. Refill or "spot up" all low areas before final approval. Remove excess material on the surface of the pavement and leave the pavement surface in a clean condition.

6. If the silicone sealant is not self-leveling, the sealant material shall be tooled in a manner that causes it to wet the joint surfaces.

7. Allow silicone sealant to cure in accordance with the manufacturer's installation instructions before reopening to traffic. Protect surface of sealer from dirt for one to three hours, until tack-free.

END OF SECTION

SECTION 02578

PAVEMENT JOINT SEALING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

02578C01 Submit to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, the following samples for approval:

1. Rubberized Asphalt Sealant - 10 pounds from each lot.
2. Silicone Sealant - one 10.3-fluid ounce cartridge.
3. Backer Rod - three-foot length

END OF APPENDIX "A"

DIVISION 2

SECTION 02580

THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for thermoplastic reflectorized pavement markings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Association of State Highway and Transportation Officials (AASHTO)
AASHTO M 247	Specification for Glass Beads Used in Pavement Markings.
AASHTO M 249	Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form).
AASHTO T 250	Standard Method of Test for Thermoplastic Traffic Line Material.
	American Society for Testing and Materials (ASTM)
ASTM D 36	Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus).
ASTM D 1155	Test Method for Roundness of Glass Spheres.
ASTM D 1214	Test Method for Sieve Analysis of Glass Spheres.
	Federal Highway Administration (FHWA)
MUTCD	Manual on Uniform Traffic Control Devices.
	Federal Standards
FED-STD-595C	Colors Used in Government Procurement.

1.03 QUALITY ASSURANCE

A. The quality and workmanship of the completed marking installation shall conform to 3.02 C.4.

B. Warranty

Arrange for the completed marking installation to be warranted to the Authority, from the date of issuance of the Certificate of Final Completion, against peeling, chipping, flaking, delamination and shoving for a period of one year. The warranty shall run to the Authority's benefit and shall grant the Authority a direct right of action against the manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Use thermoplastic material that has been manufactured in block form and packaged in suitable corrugated containers to which it will not adhere during shipment or storage. Each container shall weigh approximately 50 pounds and shall consist of blocks approximately 12 inches x 36 inches x 2 inch in size. Each container shall be sealed at the point of manufacture and plainly marked with the color, basic resin type (either hydrocarbon or alkaloid), manufacturer's name, batch number and date of manufacture, and a statement stating the contents meet the requirements of this Section. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall not be heated in excess of 440 degrees F gauge.

B. Arrange for the reflective glass spheres for drop-on application to be shipped in strong moisture resistant bags each containing approximately 50 lbs of reflective glass spheres. Each bag shall be marked with the name and address of the manufacturer, the name and weight of the material, a statement stating the contents meet the requirements of this Section, date of manufacture and batch number.

C. Arrange for primer to be shipped in pails, drums or other strong containers. Each container shall be plainly marked with the brand name of the product, the name and address of the manufacturer, the date of manufacture, the quantity of material, the date of expiration or shelf life and appropriate hazard warnings. Primers shall be shipped to the construction site with instructions for use affixed to each container.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. White and yellow reflectorized thermoplastic shall conform to AASHTO M 249.

1. Composition Requirements

The thermoplastic material composition shall be specifically formulated for application at temperatures greater than 400 degrees F true (measured with high precision laboratory grade equipment) and shall show no significant breakdown or deterioration at a true temperature of 450 degrees F.

a. The binder component shall be formulated as hydrocarbon resin or formulated as alkaloid base product, unless otherwise shown on the Contract Drawings. The pigment, beads and filler shall be uniformly dispersed in the binder resin.

b. The thermoplastic material shall be free from all skins, dirt and foreign objects and shall comply with the following requirements:

Component	Percentage by Weight White	Percentage by Weight Yellow
Binder	18.0 Min.	18.0 Min.
Titanium Dioxide	10.0 Min.	---
Glass Beads	30 - 40	30 - 40
Calcium Carbonate and Inert Fillers	42.0 Max.	*
Yellow Pigments	---	*

*Relative amounts and types of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided that the other composition requirements of this Specification are met and the yellow pigment does not contain chromates or lead.

2. Physical Properties of Composition

a. Colors

White thermoplastic composition, as placed, shall be white, free from dirt or tint, and shall match FED-STD-595C - Color 17886 . Yellow thermoplastic composition, as placed, shall be yellow, free from dirt, and shall match FED-STD-595C - Color 13538.

b. Drying Time

When applied at a temperature of 412.5 ±12.5 degrees F and in a thickness between 1/8 inch and 3/16 inch, the thermoplastic material shall be completely solid after it cools to ambient temperature and shall show no damaging effects from traffic after 2 minutes when the air temperature is 50 ±3 degrees F and after 10 minutes when the air temperature is 90 ±3 degrees F.

c. Color Retention

The thermoplastic material shall not change color during the warranty period.

d. Yellowness Index

White thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with AASHTO T 250.

e. Softening Point

The thermoplastic material shall have a softening point of 215 ±15 degrees F when tested in accordance with ASTM D 36.

f. Specific Gravity

The specific gravity of the thermoplastic material as determined by a water displacement method at 25 degrees C shall not exceed 2.15.

g. Cracking Resistance at Low Temperature

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F, applying to concrete blocks and cooling at 15 ±3 degrees F, the material shall show no cracks.

h. Impact Resistance

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F and forming test specimens, the impact resistance after cooling to ambient temperature shall be a minimum of 10 inch-pounds.

i. Flowability

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F and testing for flowability, the residue (sample weight that doesn't flow out) of the white thermoplastic shall not exceed 18 percent and the residue of the yellow thermoplastic shall not exceed 21 percent.

j. Fumes

The thermoplastic material shall not exude fumes that are toxic, obnoxious and/or injurious to persons or property when it is heated during application.

B. Reflective Glass Spheres (Mix Component and Drop-On)

Reflective glass spheres for use in the thermoplastic composition and for drop-on shall conform to AASHTO M 247 - Type 1.

1. The glass spheres shall be colorless; clean; transparent; free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70 percent of the glass beads shall be true spheres when tested in accordance with ASTM D 1155.

2. The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25 degrees C.

3. The glass spheres shall have the following gradation when tested in accordance with ASTM D 1214.

U.S. Standard Sieve	Mass % Passing
No. 20	100
No. 30	75-95
No. 50	15-35
No. 100	0-5

4. Glass spheres for drop-on shall be treated with a moisture-proof coating meeting the flow requirements of AASHTO M 247 Section 4.4, shall not absorb moisture during storage, shall remain free from clusters and shall flow freely from dispensing equipment.

C. Primer

Primer for use on both bituminous and Portland cement concretes shall be of the type recommended by the manufacturer of the thermoplastic material and shall be designed to dry tack-free in under 5 minutes.

2.02 BASIS OF ACCEPTANCE

A. Thermoplastic material will be accepted on the basis of sampling and inspection at the place of manufacture or in warehouse lots as determined by the Engineer. In addition, deliver all samples with the manufacturer's certified test results and identification of the binder formulation (e.g., "formulated as a hydrocarbon resin"). Any unauthorized tampering, opening or breaking of seals on the containers between the time of sampling and delivery to the construction site shall be cause for rejection of the material.

B. The minimum batch size of thermoplastic material when tested shall be not less than 3000 lbs., unless the total order is less than that amount.

C. Primers will be subject to approval by the Engineer prior to use. Requests for approval shall include technical data including brand name, instructions for use and hazard warnings.

D. Any rejected materials shall be immediately replaced with materials meeting the requirements of this Section.

PART 3. EXECUTION

3.01 APPLICATION EQUIPMENT

A. General

Thermoplastic application equipment will be subject to approval by the Engineer prior to the start of application.

1. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

2. Unless otherwise approved by the Engineer, all longitudinal pavement marking lines shall be striped using only mobile applicator equipment. Longitudinal pavement marking lines include broken lines (skip line), edge lines, barrier lines and solid lines as defined by the FHWA "MUTCD".

   a. Portable applicator equipment will be acceptable for placing all other markings; and for longitudinal marking where use of mobile applicator equipment is impractical, as approved by the Engineer.

3. Apply thermoplastic material to the primed pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, equipment suitable for maintaining the temperature and controlling the flow of material.

4. For heating the thermoplastic material, the applicator equipment shall include melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate "supply" vehicle or included as part of the application equipment. The kettle(s) shall be capable of automatically heating the thermoplastic material to, and maintaining it at, an indicated and accurate gauge temperature of 420 degrees F to 430 degrees F. The heating mechanism shall incorporate a thermostatically controlled indirect heat transfer medium. Direct heating of the melting kettle by flame will not be permitted.

5. Thermoplastic material temperature gauges accurate to plus or minus 15 degrees F shall be provided at both ends of each kettle and reservoir, and in each extrusion shoe, in such a manner as to be visible so that an operator can monitor the thermoplastic material temperature throughout the marking operation.

6. Applicator equipment including separate "supply" kettles shall be constructed to continuously mix and agitate the thermoplastic material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment that come into contact with thermoplastic material shall be so constructed as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that mixing and conveying parts, up to and including the extrusion shoe(s), maintain the material at the required application temperature.

7. The applicator equipment shall be so constructed as to:

   a. Ensure continuous uniformity in the dimensions of the stripe;

   b. Provide a means for cleanly cutting off stripe ends squarely;

   c. Provide a method of applying "skip" lines; and

   d. Be capable of applying various widths of traffic markings from 3 to 12 inches wide.

8. The applicator equipment shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow up to 10 lbs. per 100 sq. ft. of thermoplastic material. The bead dispenser shall be automatically operated in such a manner that it will dispense beads only while the thermoplastic material is being applied.

9. Applicator equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

B. Mobile Applicator Equipment

1. The mobile applicator shall be a truck mounted, self-contained pavement marking machine that is capable of applying hot thermoplastic material by the extrusion method. The applicator shall be equipped to maintain and apply the thermoplastic material at an indicated and accurate gauge temperature of 420 degrees F and at the widths and thicknesses specified in this Section. The applicator shall be capable of operating continuously and of installing a minimum of 20,000 linear feet of longitudinal markings in 8 hours.

2. The mobile applicator shall be equipped with melting kettle(s) or materials storage reservoir(s) and a glass bead hopper of such capacity as to allow for continuous marking operations. The kettle(s) or reservoir(s) shall be capable of heating and holding the thermoplastic material at an indicated and accurate gauge temperature of 420 degrees F.

3. The mobile applicator shall be equipped with an extrusion shoe(s) and shall be capable of marking edge line and center line stripes. The extrusion shoe(s) shall be:

   a. Closed, heat jacketed or suitably insulated units;

   b. Able to apply the molten thermoplastic at an indicated and accurate gauge temperature greater than 415 degrees F; and

   c. Capable of extruding a uniform line pre-set at 3 to 12 inches wide at a thickness of not less than 1/8 inch nor more than 3/16 inch.

4. The mobile applicator shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

C. Portable Applicator Equipment

1. The portable applicator shall be a hand operated equipment, specifically designed for placing hot extruded thermoplastic material in installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge and centerlines. The portable applicator reservoir shall be loaded with hot thermoplastic material from the supply vehicle melting kettle(s).

2. The portable applicator shall be equipped with all necessary components (including material storage reservoir, glass bead hopper, temperature gauges, bead dispenser, extrusion shoe and heating accessories) so as to be capable of holding and applying the molten thermoplastic at indicated and accurate gaufge temperatures greater than 415 degrees F; of extruding a line of generally uniform cross-section, pre-set at 3 to 12 inches in width, and at a thickness of not less than 1/8 inch nor more than 3/16 inch.

3.02 INSTALLATION

A. General

1. Apply pavement markings at the locations and in accordance with the patterns and dimensions shown on the Contract Drawings and the FHWA "MUTCD".

2. Before commencing any pavement marking Work, submit a schedule of operations to the Engineer for approval.

3. When pavement markings are applied under traffic conditions, provide all necessary qualified personnel, flags, markers and signs to maintain and protect traffic and to protect marking operations and the new markings until thoroughly set. Perform short duration lane and work area closures in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

4. Apply pavement markings in the general direction of traffic. Striping against the direction of traffic flow will not be permitted.

5. Remove all tracking marks, spilled thermoplastic and thermoplastic applied in unauthorized areas, to the satisfaction of the Engineer.

6. When necessary, establish marking alignment points at 25 ft. intervals throughout the length of the marking area, or as otherwise approved by the Engineer.

7. Apply thermoplastic pavement markings to dry pavement surfaces. At the time of installation, the pavement surface temperature shall be a minimum of 55 degrees F and the ambient temperature shall be a minimum of 49 degrees F and rising.

B. Surface Cleaning and Preparation of Pavement

1. Clean the pavement surfaces to be marked to the satisfaction of the Engineer immediately prior to priming and marking application. Perform surface cleaning and preparation only in the area of the thermoplastic markings application.

2. At the time of application of the thermoplastic material, ensure that all pavement surfaces are dry, free of oil, dirt, dust, grease and similar foreign materials and that the primer is tack-free.

C. Application

1. Apply a primer to all pavement surfaces (new and existing) to be marked. Apply primer to bituminous concrete and Portland cement concrete pavements, as applicable, at the rates and in accordance with the recommendations of the manufacturer of the thermoplastic material. The primer shall dry tack-free in less than 5 minutes.

2. Apply the thermoplastic material at an indicated and accurate gauge temperature no lower than 415 degrees F at the point of deposition. As used in this Section, the point of deposition shall be defined as within the extrusion shoe.

3. Immediately following application, drop reflective glass spheres onto the molten thermoplastic marking at the rate of 5 lbs. per 100 sq. ft. of composition.

4. Upon cooling to ambient pavement temperature, the resultant marking shall be a well-adhered reflectorized strip of a thickness not less than 1/18 inch nor more than 3/16 inch, and of the width and dimensions shown on the Contract Drawings, capable of resisting deformation by traffic. The exposed marking surface shall be smooth, with no pockmarks, blisters or other surface blemishes evidencing improper application, improper temperature or equipment malfunction. The pavement markings shall show a smooth alignment with continuous uniformity of the required dimensions and widths.

END OF SECTION

SECTION 02580

THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

02580D01 Submit detailed catalog cuts, manufacturer's specifications and test data of products proposed for use demonstrating conformance to the requirements of this Section,in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 2

SECTION 02588

TRAFFIC PAINT PAVEMENT MARKINGS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the installation of new painted pavement markings and the removal of any related or conflicting pavement markings. The Contractor shall furnish and apply pavement marking paints, including glass beads thereto, at the locations and in accordance with patterns indicated on the Contract Drawings or as instructed by the Engineer, and in conformance with these Specifications.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	Federal Highway Administration (FHWA)
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
	American Society for Testing and Materials (ASTM International)
ASTM D562	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
ASTM D1155	Standard Test Method for Roundness of Glass Spheres
ASTM D1213	Standard Test Method for Crushing Resistance of Glass Spheres
ASTM D1214	Standard Test Method for Sieve Analysis of Glass Spheres
ASTM D1535	Standard Practice for Specifying Color by the Munsell System
ASTM D2805	Standard Test Method for Hiding Power of Paints by Reflectometry
ASTM E1347	Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Federal Specification – (Reference specification for testing procedures only. See Part 2 of this Section for complete specification requiremens.)

1. A-A-2886B, Oct. 10, 2004
2. Federal Test Method Standard 141D, dated March 22, 2001 (or more recent) Paint, Varnish, Lacquer, and Related Materials.
3. Current ASTM tests.

1.04 QUALITY ASSURANCE

A. Warranty

The pavement markings shall be warranted by the Contractor against abrasion, bleeding, blistering, chipping, cracking, fading, flaking, loss of adhesion, peeling, softening, or other deterioration for a period of 6 months from the date of installation or until the markings are normally worn away by traffic.

B. Tolerances

1. Width of Lines: Minus zero, plus 1/8 inch.
2. Length of skip or lane lines and unpainted surface between the skip lines shall be plus or minus 3 inches.
3. Location of Directional Arrows, Messages, and Stripes Within 2 inches of locations shown on the Contract Drawings.
4. Size of Letters and Arrows: Plus or minus 2 inches.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Formulation and Manufacturing - The paint shall be formulated and manufactured from first grade raw materials and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The materials shall show no hard settling or gelling upon storage in the sealed containers as received that will affect the performance of the product. The paint shall be furnished ready for use. No additional thinner shall be added. Total volatile organic substances (VOC's) in the paint shall not exceed 2.08 lbs/gal. (250 grams/liter). The paint shall contain less than .06% lead or chromium in final composition.

B. Directional Reflectance - The daylight directional reflectance of the white paint (without glass spheres) shall not be less than 84% and not less than 54% for yellow (relative to magnesium oxide), when tested in accordance with ASTM E1347. Furthermore, the yellow shall substantially match the "Light Limit V +" chip on the Highway Yellow Color Tolerance Chart (PR Color #1, June 1965). Yellow shall conform to the Federal Standard 595a No. 33538.

C. Flexibility - The paint shall show no cracking or flaking when tested in accordance with Federal Specification A-A-2886A Section 3.4.

D. Bleeding - The paint shall have a minimum, bleeding ratio of 0.90 when tested in accordance with Federal Specification A-A-2886A. The asphalt-saturated felt shall conform to Federal Specification HH-R-590.

E. Weight/Gallon - The paint shall have a minimum weight per gallon of 14.5 yellow; 15.1 white.

F. Viscosity - The consistency of the paint shall be not less than 75 or more than 100 Krebs Units at 25 C, when tested in accordance with ASTM D-562.

G. Dry Opacity - ASTM D-2805, The film shall be applied with a .005 inch Bird Applicator. The minimum Contract Ratio of the white and yellow paint shall be 0.96.

H. Water Resistance - The paint shall conform to Federal Specification TT-P-85e, Section 3.4.7. There shall be no blistering or appreciable loss of adhesion, softening or other deterioration after examination.

I. Field Drying Time - The paint, when applied at 11 mils +/- 1 mil wet film thickness and 160 F at the gun and with a glass spheres at the rate of six pounds per gallon of paint, shall dry to no pickup under 1 minute when tested by simulated passing with a passenger car. A line showing no visual deposition of the paint to the pavement surface when viewed from a distance of fifty feet shall be considered non-tracking and conforming to the requirement of the field drying time.

J. Lab Drying Time – Dry to no-pick-up time in 3 minutes maximum at an application rate of 15 ± 1 mils wet-film thickness and glass-sphere application rate of 20 lb/gal (ASTM D711).

K. Fineness of Grind - The paint shall have a minimum fineness of grind of 3 Hegman.

L. Total Non-Volatile - The paint shall have a total non-volatile content of not less than 85% by weight.

M. Abrasion Resistance - No less than 35 Liters of sand shall be required for removal of the baked paint film. The abrasion resistance test shall be in accordance with TT-P-85e, Section 3.5.2.1 (10 Liters per mil of dried paint).

N. Shelf Life - The paint shall have a usable shelf life of not less than 6 months. The paint shall have no hard settling, caking or separation. The paint shall be able to be mixed easily by means of mechanical stirrer. Paint is to be stored in inside structures at normal room temperature.

O. The paint shall be lead and chromium-free (less than .06%).

P. The dried paint shall match Federal Color Standards -- White 595a, Yellow 33538, Green 34108 and Blue 35180.

Q. Appropriate cleaning solvents are to be prescribed. These solvents are to be environmentally safe per NY & NJ Regulations.

R. Material Safety Data Sheets (MSDS) are to be part of every shipment and test sample of paint and cleaning solvent.

S. The beads for reflectorizing the paint shall be glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering. The beads shall be colorless; clean, transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres.

1. The silica content of the glass beads shall not be less than 60%.

2. The beads shall have a refractive index between 1.50 and 1.65 when tested by the liquid immersion method at 25 C.

The spheres shall meet the following gradation:U.S. Standard Sieve	Min.	Max.
Passing No. 20; Retained No. 30	5%	20%
Passing No. 30; Retained No. 50	30%	75%
Passing No. 50; Retained No. 80	9%	32%
Passing No. 80	0%	10%

3. The beads shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. They shall flow freely, and to the satisfaction of the Engineer, from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for painting.

4. The glass beads shall be packed in waterproof, plastic lined burlap or plastic lined paper bags. Each bag shall be marked:
   - Manufacturer's Name
   - Name of Product
   - Size/Type/Coating
   - Lot/Batch Number
   - Manufacture Date
   - Quantity/Net Weight of Material

T. Testing of Glass Beads - The properties indicated above shall be determined in accordance with the following methods of test:

1. Sphericity - Irregularly shaped particles (out-of-round) shall be tested in accordance with ASTM D1155.

2. Gradation - Tested in accordance with ASTM D1214.

3. Moisture Resistance - The spheres shall pass the following moisture resistance test:

   Place two pounds of spheres in a washed cotton bag, having a thread count of 50 per square inch (warp and woof) and immerse the bag in a container of water for 30 seconds. Remove the bag and force excess water from the sample by squeezing the bag. Suspend and allow to drain for two hours at room temperature (70-72 F). Then, mix the sample in the bag by shaking thoroughly. Transfer sample slowly to a clean, dry glass funnel having a stem 4" in length, with 3/8" inside diameter stem entrance opening and a minimum exit opening of 1/4". The entire sample shall flow freely through the funnel without stoppage. When first introduced into the funnel, if the spheres clog, it is permissible to lightly tap the funnel to initiate the flow.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. All final, interim and temporary pavement markings and patterns shall be placed as shown on the Contract Drawings and in accordance with the Federal MUTCD.

2. Before any final pavement marking work is begun, a schedule of operations shall be submitted to the Engineer for approval. A schedule for temporary markings and patterns for detours and other temporary traffic controls shall also be submitted to the Engineer for approval prior to placement. At least 48 hours advance notice must be given to the Engineer before performing any pavement marking work.

3. When pavement markings are applied under traffic the Contractor shall provide all necessary flaggers, signs, and other traffic control devices to maintain and control traffic, and to protect the marking operation and the new markings until thoroughly dry. The application of pavement markings shall be done in the general direction of traffic; striping against traffic shall not be allowed. Short duration lane and work area closures shall be in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

4. The Contractor shall be responsible for cleaning the pavement to the satisfaction of the Engineer, of dust, dirt and other foreign material that may be detrimental to the adhesion of the paint film.

5. Detour and other temporary or conflicting markings shall be removed as soon as practicable as directed by and to the satisfaction of the Engineer. If darkness or inclement weather interferes with the removal operations, such operations shall be accomplished during the next daylight period or as soon thereafter as weather permits.

6. The method of removal is subject to the approval of the Engineer. Painting out pavement markings is generally not permitted, and if approved will only be permitted for very short-term use. Grinding, scraping, sandblasting, etc., must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist.

7. When necessary, the Contractor shall establish marking line points at 30 foot intervals throughout the length of the pavement, or as directed by the Engineer.

8. The paint shall be applied in strict accordance with the manufacturer's recommendations for use. Further, at the time of application pavement surfaces shall be thoroughly dry.

B. Application of Pavement Markings

1. Except as noted herein painted pavement markings shall be applied with atomizing spray type striping machines. The striping equipment may be either truck mounted or hand operated. All equipment shall be compatible with and suitable for the application of the type of paint being used.

2. Applied markings shall have clean-cut edges, true and smooth alignment and a minimum uniform wet film thickness of 15 mils. Glass beads shall be applied uniformly over and into the wet paint film at the rate of 6 lbs. per gallon of paint. Glass bead dispensers shall be of a type that will mechanically and automatically give such performance.

3. Upon approval by the Engineer, paint rollers or brushes may be used for marking cross-hatched and solid painted gore areas, letters, symbols, stop bars, short temporary detours or other such areas as directed by the Engineer. When rollers and brushes are allowed, glass beads shall be applied to the wet paint film at the specified rate and in a manner suitable to the Engineer.

4. The Contractor shall repaint, or remove and reapply, any pavement markings that fail to satisfy the requirements specified in this Section, at no cost to the Authority.

5. The Contractor shall continuously monitor, maintain, and repair all installed pavement markings until completion of the Contract.

END OF SECTION

SECTION 02588

TRAFFIC PAINT PAVEMENT MARKINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

02588D01 Catalog cuts, manufacturer"s specifications and test data of pavement marking paints, including glass beads

Construction and Installation Procedures

02588G01 Proposed means of cleaning, removing, or obliterating existing or unsatisfactory markings prior to commencing corrective work

Schedules

02588J01 Schedule of pavement marking to be performed

END OF APPENDIX "A"

DIVISION 2

SECTION 02610

EXTERIOR SANITARY SEWER GRAVITY SYSTEM

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for exterior sanitary sewer gravity systems.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

American Society for Testing and Materials (ASTM)

ASTM A 746	Ductile Iron Gravity Sewer Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 822	Terminology Relating to Concrete pipe and Related products
ASTM C 924	Standard Practice for Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
ASTM C 969	Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 1103	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D 883	Standard Terminology relating to Plastics
ASTM D 2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D 2680	Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride)(PVC) Composite Sewer Piping

ASTM D 2751	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	Poly(Vinyl Chloride) (PVC) Large diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
	American Water Works Association (AWWA)
AWWA C 104	Cement-Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with sanitary sewer piping systems and appurtenances of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced, at no additional cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe to prevent damage to Authority or other public or private property and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal.

A. Ductile Iron Sewer Pipe and Fittings

American Cast Iron Pipe Co., North Birmingham, Alabama
Griffin Pipe Products Co., Downers Grove, IL.
McWane, Inc., Birmingham, Alabama
Atlantic States Cast Iron Pipe Co. Phillipsburg, NJ
U.S. Pipe and Foundry Co., Orlando, FL.

B. Gaskets

Hamilton Kent Manufacturing Co., Toronto, Ontario
Diplomatic Marine, Inc., Houston, TX
General Sealants, Inc., Anaheim, CA

C. Reinforced Concrete Pipe

N.J. Concrete Pipe Co., Bayonne, NJ
Price Bros., Inc., Dayton, OH
Vianini Pipe, Inc., Somerville, NJ

D. Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
J. M. Manufacturing
Contech Construction Products, Inc., Wappingers Falls, NY

2.02 MATERIALS

Use any of the pipe systems specified below unless otherwise shown on the Contract Drawings or specified herein.

A. Ductile Iron Gravity Sewer Pipe and Fittings

1. ASTM A 746, thickness Class 50 unless otherwise shown on the Contract Drawings, with push-on joints, and cement mortar lining, that shall be twice the standard thickness specified in AWWA C 104.
2. In uncontaminated soil, joints shall be sealed with continuous ring rubber gaskets conforming to AWWA C 111.
3. Where pipe installation in contaminated soil is shown on the Contract Drawings, use neoprene gaskets conforming to AWWA C 111.

B. Reinforced Concrete Pipe

1. ASTM C 76, Class V, Wall B or Wall C, unless otherwise shown on the Contract Drawings. Use ASTM C 150, Type II Portland cement. Pipe joints shall be tongue and groove or bell and spigot, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. In uncontaminated soil, pipe joints shall be sealed with rubber gaskets. Design of joints and physical requirements for rubber gaskets shall conform to ASTM C 443. Rubber gaskets shall be the following types of rubber gaskets manufactured by Hamilton Kent Manufacturing Co., or approved equal:

   a. "Tylox Type C" for straight tongue and groove pipe

   b. "Tylox Superseal " for offset pipe

   c. "Tylox Type 0" for recessed pipe

3. Where pipe installation in contaminated soil is shown on the Contract Drawings, pipe joint shall be sealed with a continuous rubber ring gasket and with a preformed plastic gasket. Plastic gasket shall conform to AASHTO M 198, except that gasket size, lengths, quantity of primer and packing material shall be in accordance with the gasket manufacturer's recommendation. Preformed flexible plastic gaskets shall be the following, or approved equal:

   a. "Ram-Nek", as manufactured by Diplomatic Marine, Inc.

   b. "GS-79" as manufactured by General Sealants, Inc.

C. Plastic Pipe

1. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings

   ASTM D 3034, bell and spigot push-on type joint with rubber "0" ring gasket, SDR (Ratio of the outside pipe diameter to minimum wall thickness) not greater than 35 for sizes 3 to 15 inches in diameter and ASTM F 679 for sizes 18 to 36 inches in diameter

2. Joints shall meet the requirement of ASTM D 3212 and gaskets shall conform to ASTM F 477.

3. Where contaminated soil is shown on the Contract Drawings, plastic pipe and fittings shall not be permitted.

D. Manholes and Other Structures

Manholes and other structures shall be in accordance with the requirements of the Section entitled "Manholes and Drainage Structures."

E. Polyethylene Encasement for Ductile Iron Sewer Pipe and Cast Iron Soil Pipe, AWWA C 105, Class C polyethylene, 8-mil thickness.

F. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the sewer line is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Contract Drawings.
2. For plastic pipe installations, remove all rocks or other hard objects larger than 1-1/2 inches in size from the area within 12 inches of the pipe.
3. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. Or the Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load. A subtrench is defined as a trench excavated for pipe placement within a wider trench.
4. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer. Pipe shall be laid in a dry trench.

B. Pipe Support and Backfilling

1. For plastic pipe installations, do not use blocking or mounding to bring the pipe to grade. Conform to the applicable requirements of ASTM D 2321.
2. Where concrete cradles are shown on the Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section entitled "PORTLAND CEMENT CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.
3. Where crushed stone bedding is shown on the Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for pipe bells, where applicable, so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted crushed stone material, place and compact additional crushed stone bedding material to the dimensions as shown on the Contract Drawings.
4. Continue backfilling of the trench from the pipe support limits reached in 3.02 B.2 and 3 above in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING."

C. Pipe Installation

1. Immediately prior to placement in the trench, all pipe and appurtenances shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be immediately removed from the construction site and replaced to the satisfaction of the Engineer and at no additional cost to the Authority.

2. When lowering pipe and appurtenances into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

3. Lay pipe true to line and grade, with uniform bearing under the full length of the barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to the line and grade shall be made by scraping away or adding material under the pipe.

4. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

5. Make up pipe joints in accordance with the manufacturer's instructions taking extreme care that joints are clean and free of foreign materials. Support pipe free of bedding during the joining process to avoid disturbing the subgrade. Pipe joints shall be sufficiently tight to meet testing specified herein.

6. In large diameter sewers with compression-type pipe joints, or where considerable force is required to insert the spigot fully into the bell, come-alongs and winches or other equipment may be rigged to provide the necessary force. Inserts shall be used to prevent the sewer pipe from being thrust completely home prior to checking gasket location. After the gasket is checked, the inserts shall be removed and the joint completed.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement prior to backfilling ductile iron sewer pipe.

3.03 FIELD TESTS

Unless otherwise shown on the Contract Drawings, test all installed sewer pipe by infiltration/exfiltration test except that an air test will be required in lieu of the exfiltration test during the period that a Federal, State, or local "Water Drought Emergency" has been officially declared. Testing shall be performed in the presence of the Engineer.

A. Infiltration/Exfiltration Test

1. Equipment and procedures used in performing the infiltration/exfiltration test shall be in accordance with ASTM C 969 and subject to the approval of the Engineer.

2. Measure infiltration with a weir or other suitable measuring device.

3. The allowable infiltration rate including manholes shall be 200 gallons/inch of internal diameter/mile of sewer tested/24 hours, when the average groundwater head on the test section is 6 feet or less. When the average groundwater head on the test section is over 6 feet, the allowable infiltration rate shall be that given above multiplied by the ratio of the square root of the average groundwater head to the square root of the base head of 6 feet. If the infiltration rate exceeds the allowable limits given above, take the following remedial action:

   a. Take up and relay entire length of pipe, or

   b. At the Contractor's option, conduct additional tests to determine if excess infiltration can be attributed to a portion of the line. If it can, replacement may be confined to the faulty portion.

   c. Repeat tests until all pipelines prove satisfactory.

4. When an infiltration test is not practicable because of dry trench conditions, perform an exfiltration test. For exfiltration testing, the allowable leakage limit including manholes shall be 200 gallons/inch of internal diameter/mile of sewer tested/24 hours, when the average head on the test section is 3 feet or less. When the average head on the test section is greater than 3 feet, the allowable leakage shall be that given above multiplied by the ratio of the square root of the average test head to the square root of the base test head of 3 feet. Perform exfiltration tests, where directed by the Engineer, as follows:

   a. Fill sewer between successive manholes using a manhole standpipe system to provide test head.

   b. Determine leakage by measuring water required to maintain test head for required test period.

   c. If exfiltration leakage exceeds the rate specified above proceed with the remedial action specified in 3.03 A.3.

5. Brace the test line in both lateral directions to prevent movement of pipe.

6. Submit one copy of all test result data to the Engineer on a daily basis.

B. Air Test

1. Equipment and procedures used in performing the air test for Reinforced Concrete Pipe and Ductile Iron Pipe shall be subject to the approval of the Engineer and in accordance with ASTM C924 for pipes up to 24 inches diameter and ASTM C1103 for pipes greater than 24 inches diameter.

2. Equipment and procedures used in performing the air test for Polyvinyl Chloride Pipe shall be subject to the approval of the Engineer and in accordance with ASTM F 1417.

3. The Contractor is directed to the safety precautions necessary when performing air tests as specified in ASTM C924, ASTM C1103 and ASTM F 1417.

4. Unless otherwise approved by the Engineer, the lines shall be tested from structure to structure.

5. Coat all capped and plugged fittings and all joints with soap solution to detect leakage.

6. Air control equipment shall be equipped with proper valves and pressure gages capable of controlling the air entry rate to the test section and monitoring the air pressure in the pipeline. The pressure relief valve shall be tested to ensure it is functioning properly.

7. Supply air to the test section slowly, filling the pipe until the minimum required test pressure, not to exceed 5 psig, is maintained. When groundwater elevation above the pipe indicates a test pressure in excess of 5 psig, discontinue air testing and conduct an infiltration test.

8. The minimum test time shall be as specified in ASTM C 924 or ASTM C 1103 or ASTM F 1417. Where the test section includes laterals or pipes of different sizes, determine equivalent length by the ratio of the square of the diameter to the square of the diameter of the main line in accordance with Appendix X1 of ASTM C 924.

9. If the pipe section or joint exceeds the allowable pressure loss specified by ASTM C 924 , ASTM C 1103 and ASTM F 1417 respectively, the section or joint shall be considered to have failed the test. Repairs shall be made as specified in 3.03 A.3 above.

10. Submit one copy of all test result data to the Engineer on a daily basis.

3.04 PROTECTION

A. Care shall be taken not to damage or displace installed pipe and joints during construction of pipe supports, backfilling testing and other activities.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to retesting of joints, relaying pipe or replacing pipe. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

SECTION 02610

EXTERIOR SANITARY SEWER SYSTEM

SUBMITTALS

APPENDIX "A"

A. Submit catalog cuts of pipes and gaskets for pipe joints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the requirements specified in this Section and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified in this Section.

D. Submit to the Chief of Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data covering gradation and composition of crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag that shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

E. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of a accumulation of groundwater specified in 3.02.
2. Alternate method of line and grade control specified in 3.02.
3. Infiltration/exfiltration and/or air testing specified in 3.03.

F. Submit results of the tests specified in 3.03 on a daily basis.

G. Submit "As Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02639

BRIDGE DRAINAGE SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements of piping and appurtenances for the installation of the bridge drainage system.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below:

New York City Building Code
New York City Plumbing Code
New Jersey Building Code
New Jersey Uniform Plumbing Code
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Water Works Association (AWWA)
Underwriters Laboratories Inc. (UL)
In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Bridge Drainage system piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing Work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Provide pipe, fittings, and flanges in accordance with the "PIPE, FITTINGS, AND FLANGES SCHEDULE" specified below, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of piping systems.

B. Nipples shall be extra-heavy shoulder type of same material as pipe; close nipples are not acceptable.

C. Gaskets for flanges shall be 1/16-inch thick (after compression), rubber or neoprene, full-faced, and punched bolt holes.

D. Grooved Piping Mechanical Couplings

1. Couplings shall be complete with gaskets, bolts and nuts recommended by the manufacturer for the service. Use vandalproof nuts and bolts on piping accessible to pedestrian traffic.
2. Couplings shall be Victaulic "Style 75" lightweight for system pressure not exceeding 400 psi. Coating shall be hot dipped galvanized, unpainted.
3. Couplings shall be manufactured by Victaulic Co. of America; Tyler Pipe Subsidiary, Tyler Corp./Gustin-Bacon Division; Gruvlock Couplings by Grinnell; or approved equal.

PIPE, FITTINGS, AND FLANGES SCHEDULE

SYSTEMS	PIPE	FITTINGS AND FLANGES
Bridge Drainage Systems Schedule 40	Galvanized Steel, ASTM A795 or A53,	A. Black Malleable Iron, ANSI B16.3 or Ductile Iron AWWA C110, 300 lb. Class, 500 psi w.w.p., Threaded B. Companion Flanges, Cast Iron, ANSI B16.1, 125 lb. Class C. Ductile Iron ASTM A 536, Grooved, Mechanical Type Couplings and Gaskets

All fittings and flanges shall be galvanized.

2.02 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Provide hangers and supports, with beam clamps, restraints, supplemental steel, inserts, fish plates, mounting devices, and similar items to support piping in alignment without sagging or interference, and to permit complete drainage and free expansion and contraction.

C. All hangers and supports shall be capable of adjustment after piping is erected and shall be provided with a locking nut (double nut) to prevent loss of adjustment.

D. Where required, provide anchors, sway bracing, blocking and steel to connect to structure to prevent excessive pipe movement that could cause damage due to expansion, contraction, or thrust.

E. All pipe hangers, inserts, supports, supplemental steel, rods, and components shall be galvanized.

F. Hangers and supports shall be manufactured by Grinnel Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.03 PIPE JOINTS

A. Ball Joints:

1. Ball joints shall be Type N Style I Ball joints, as manufactured by Hyspan Barco, or approved equal with operating characteristics as scheduled on the contract drawings.
2. 150 lb Flange ends
3. Minimum flex angle of 17 degrees
4. Non-corrosive seal
5. Hot dipped galvanized steel body
6. Rated 150 psi
7. UL/FM approved

B. In-Line Expansion Joints

1. In-line expansion joints shall be model 3500-IS, as manufactured by Hyspan Barco, or approved equal with operating characteristics as scheduled on the contract drawings.
2. 150 lb Flange ends for 150 psi working pressure
3. Inconel bellows
4. Minimum flex angle of 17 degrees
5. Three ply externally pressurized
6. ASTM A53B Hot dipped galvanized steel body
7. Internal vented guiding
8. Rated 150 psi
9. Minimum fatigue life of 100 cycles at the full range of motion

2.04 SCUPPERS AND GRATES

A. Scuppers and grates shall be furnished and installed as per the installation details found within the contract drawings.

B. All material shall be galvanized in accordance with NYS Standard Specifications Subsection 719-01.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping and appurtenances in accordance with manufacturers' installation procedures.
2. Perform necessary cutting and patching in accordance with requirements specified in the Section of Division 2 entitled "CUTTING, PATCHING AND REMOVAL".
3. Install pipe expansion joints adjacent to each roadway finger joint. Maximum travel of the pipe joint shall match maximum travel of the finger joint. Joint shall be anchored on either side and guided along its entire length per manufacturer's recommendations.

B. Piping

1. Install piping as shown on the Contract Drawings and straight and direct as possible, forming right angles or parallel lines with structural members with risers plumb and true.
2. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing pipe, thoroughly clean the inside free of cutting and foreign matter. Cut all pipe square and smooth and make up all joints to required limits.
3. Make changes in pipe size by the use of reducing fittings. Do not use reducing bushings except by approval of the Engineer.
4. All piping shall be thoroughly blown out, rodded out, or washed out at least twice, in a manner as directed and approved by the Engineer, to remove all accumulation of dirt, chips or other deleterious materials. Make all temporary connections and furnish all appliances required for the purpose of cleaning.
5. Grooved pipe and fittings shall be clean and free from indentations, projections and tool marks in the area from pipe end to groove for proper gasket sealing. Provide a thin uniform coat of lubricant on the suitable gasket intended for specified service as recommended by the manufacturer. Place the gasket over one pipe end, align pipe ends and bring together, positioning the gasket between the groove on each pipe end. Assemble the housing over the gasket with housing key section engaging both grooves. The bolts shall be inserted, nuts started and uniformly tightened until the housing bolt pads are firmly seated together, metal to metal.
6. Flanged joints shall be made up square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.
7. Joints between copper or brass and steel pipe shall be made by using a dielectric coupling.

3.02 FIELD TESTS

A. Notify the Engineer, at least 48 hours in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.

B. Perform all tests prior to painting or concealing.

C. Isolate all equipment, controls and instruments from the piping system during the required tests.

D. Provide and install necessary equipment, instruments, hardware, temporary piping, vents, drains, and include necessary personnel required to perform all tests.

E. Perform hydrostatic tests for all sections of the piping system at not less than 100 psi pressure for two hours, or at 50 psi in excess of the maximum pressure, when the maximum pressure to be maintained in the system is in excess of 150 psi. The test pressure shall be read from a gauge located at the low elevation point of the individual system or portion of the system being tested.

F. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make necessary corrections immediately and flush, clean and retest the system for the Engineer's approval at no cost to the Authority.

G. Repair or replace any portion of the system installed under this Section that is damaged as a result of test operations at no cost to the Authority.

H. Where piping installed under this Section is connected to any existing system, such installed piping shall be isolated from the existing system during the performance of the required field tests, unless otherwise directed by the Engineer.

I. The Engineer reserves the right to direct the Contractor not to isolate the newly-installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, all as directed by the Engineer and at no additional cost to the Authority.

J. Dispose of water removed from pipelines in a manner that shall not cause damage to any property.

END OF SECTION

SECTION 02639

BRIDGE DRAINAGE SYSTEM

APPENDIX A

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Detailed piping layout drawing, including hanger and support locations and details, with load calculations where required.

B. Catalog cuts, including product data for the following:

1. Fittings and flanges
2. Expansion joints and ball joints
3. Hangers and supports
4. Other specialty items specified in this Section
5. Piping material and schedule for each piping system

C. Submit operation and maintenance manuals, including replacement and spare parts lists where such parts are required.

D. Submit field test results, and include in operation and maintenance manual

END OF APPENDIX "A"

DIVISION 2

SECTION 02662

EXTERIOR WATER SUPPLY SYSTEM FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY FACILITIES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for ductile iron pipe, gate valves, tapping sleeves and appurtenances used for exterior water supply systems for Port Authority of New York and New Jersey facilities. All products, including coatings, rubber gaskets and cement mortar lining, shall comply with the requirements of ANSI/NSF-61.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ANSI/NSF-61	Drinking Water Systems Components-Health Effects
	American Society for Testing and Materials (ASTM)
ASTM A240	Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A48	Specification for Gray Iron Castings
ASTM A536	Specification for Ductile Iron Castings
ASTM B88	Specification for Seamless Copper Water Tube
ASTM C117	Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
	American Water Works Association (AWWA)
ANSI/AWWA C104	Cement - Mortar Lining for Ductile-Iron Pipe and Fittings
ANSI/AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
ANSI/AWWA C110/	Ductile-Iron and Gray-Iron Fittings

ANSI/AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C151	Ductile-Iron Pipe, Centrifugally Cast
ANSI/AWWA C153	Ductile-Iron Compact Fittingsfor Water Service
ANSI/AWWA C223	Fabricated Steel and Stainless Steel Tapping Sleeves
ANSI/AWWA C502	Dry-Barrel Fire Hydrants
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
ANSI/AWWA C550	Protective Interior Coatings for Valves and Hydrants
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
ANSI/AWWA C651	Disinfecting Water Mains
	The Society for Protective Coatings (SSPC)
SSPC-SP 3	Power Tool Cleaning
	National Fire Protection Association (NFPA)
NFPA 24	Installation of Private Fire Service Mains and Their Appurtenances
	Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry
MSS SP-60	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

1.03 QUALITY ASSURANCE

A. Installer Qualifications

The entity performing the Work of this Section must have at least three years of installation experience on projects with piping systems of types and sizes similar to those required under this Contract.

B. Test Requirements

1. Prior to delivery of crushed stone bedding to the construction site, submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, one 75-pound representative sample of crushed stone in a clean, sturdy container or bag that shall not permit loss of any of the material.

2. Clearly label the container or bag of the sample with Contract location, title and number; the name of the material supplied; and location of the source.

3. The Engineer will approve or disapprove the representative sample within 21 days after receipt of the representative sample.

4. Do not deliver crushed stone bedding material to the construction site until the Engineer has approved the submittal in writing.

5. After delivery of the crushed stone bedding material to the construction site, the Engineer will take a sample for testing. Do not place stone until Engineer has approved the stone for use. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered material from the construction site and replace it with material that does conform, all at no additional cost to the Authority.

1.04 DELIVERY, STORAGE, AND HANDLING

A. As approved by the Engineer, stack or lay the ductile iron pipe delivered to the construction site along the route where the ductile iron pipe will be installed, or alternatively, in the Area Available for Contractor's Use, if such area is shown on the Contract Drawings. Stack ductile iron pipe in accordance with requirements of ANSI/AWWA C600.

B. Ensure that the ductile iron pipe, fittings, gate valves, fire hydrants and appurtenances are not damaged and are kept clean at all times. Ductile iron pipe, fittings, gate valves, fire hydrants or appurtenances that are damaged will be rejected and shall be replaced in kind by the Contractor at no additional cost to the Authority.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Ductile Iron Pipe - 4 Inches and Larger

Manufacturer of the push on joint or mechanical joint ductile iron pipe shall be one of the following. No substitutions will be permitted.

American Cast Iron Pipe Company of Birmingham, AL

Griffin Pipe Products Company, Incorporated of Downers Grove, IL

McWane, Incorporated of Birmingham, AL, which includes Atlantic States Cast Iron Pipe Company of Philipsburg, NJ, McWane Cast Iron Pipe Company of Birmingham, AL, Pacific States Cast Iron Company of Provo, UT, and Clow Water Systems Company of Coshocton, OH

United States Pipe and Foundry Company LLC of Birmingham, AL

1. Push On Joint and Mechanical Joint Ductile Iron Pipe

a. Push on joint and mechanical joint ductile iron pipe shall conform to ANSI/AWWA C151, Special Thickness Class 52. Ductile iron pipe shall be furnished with interior cement-mortar lining that is twice the standard thickness specified in ANSI/AWWA C104, and an exterior asphaltic coating that is approximately 1 mil thick. Rubber gaskets shall conform to ANSI/AWWA C111.

b. Where joint restraint is required for push on joint ductile iron pipe, use one of the compatible following systems, as approved by the ductile iron pipe manufacturer, to restrain push-on joints:

(1) "FIELD LOK 350" or "FIELD LOK" gaskets as manufactured by United States Pipe and Foundry Company LLC of Birmingham, AL and Griffin Pipe Products Company, Inc. of Downers Grove, IL

(2) "SURE STOP 350" gaskets as manufactured by McWane, Inc. of Birmingham, AL

(3) "HP LOK" as manufactured by United States Pipe and Foundry Company LLC of Birmingham, AL

(4) "TR FLEX", including "TR FLEX GRIPPER Rings" as manufactured by United States Pipe and Foundry Company LLC of Birmingham, AL

(5) "FLEX-RING", including "Field Flex-Ring" as manufactured by American Cast Iron Pipe Company of Birmingham, AL

(6) "Fast-Grip" gaskets as manufactured by American Cast Iron Pipe Company of Birmingham, AL

(7) "SNAP-LOK" or "BOLT-LOK" as manufactured by Griffin Pipe Products Company, Inc. of Downers Grove, IL

(8) "Super-Lock" as manufactured by Clow Water Systems Company of Coshocton, OH

c. Where joint restraint is required for mechanical joint ductile iron pipe, use one of the compatible following systems, as approved by the ductile iron pipe manufacturer, to restrain mechanical joints:

(1) "BOLT-LOK", including "BOLT-LOK FC", for ductile iron pipe 4 inches through 24 inches, as manufactured by Griffin Pipe Products Company of Downers Grove, IL

(2) "MEGALUG" series for ductile iron pipe 4 inches through 48 inches, as manufactured by EBAA Iron Sales, Inc. of Eastland, TX

(3) "MJ FIELD LOK" as manufactured by United States Pipe and Foundry Company LLC of Birmingham, AL, Union Foundry Company of Birmingham, AL, or McWane, Incorporated of Birmingham, AL, which includes Atlantic States Cast Iron Pipe Company of Philipsburg, NJe, McWane Cast Iron Pipe Company of Birmingham, AL, Pacific States Cast Iron Company of Provo, UT, and Clow Water Systems Company of Coshocton, OH

(4) "ONE-LOK Series SLD" as manufactured by Sigma Corporation of Cream Ridge, NJ

(5) "Uni-Flange Series 1400" as manufactured by The Ford Meter Box Company, Inc. of Wabash, IN

(6) "RomaGrip" as manufactured by Romac Industries, Inc. of Bothell, WA.

B. Fittings shall be ductile iron conforming to ANSI/AWWA C110 and ANSI/AWWA C153. Ductile iron fittings shall be furnished with interior cement-mortar lining that is twice the standard thickness specified in ANSI/AWWA C104, and an exterior asphaltic coating that is approximately 1 mil thick or, alternatively, coated with a minimum 6 mil thick fusion-bonded epoxy coating on the interior and exterior conforming to ANSI/AWWA C116. Joint type shall be push on or mechanical. Manufacturer of the ductile iron fittings shall be one of the following. No substitutions will be permitted.

American Cast Iron Pipe Company of Birmingham, AL

Griffin Pipe Products Company, Inc. of Downers Grove, IL

McWane, Inc. of Birmingham, AL, which includes Atlantic States Cast Iron Pipe Company of Philipsburg, NJ, McWane Cast Iron Pipe Company of Birmingham, AL, Pacific States Cast Iron Company of Provo, UT, and Clow Water Systems Company of Coshocton, OH

United States Pipe and Foundry Company LLC of Birmingham, AL

Sigma Corporation of Cream Ridge, NJ

Union Foundry Company of Anniston. AL

C. Copper Tubing - 2 Inches and Smaller: ASTM B88, Type K, O50.

D. Fittings for Copper Tubing

ANSI B16.18 solder joint pressure fitting, flared joint fitting or compression fitting.

E. Fire Hydrant

1. Fire hydrant shall meet or exceed the requirements of ANSI/AWWA C502 and shall be furnished with a 5-1/4 inch main valve opening and a mechanical joint inlet connection. The size and thread configuration for the pumper nozzle (1 required) and hose nozzle (2 required) as well as the size and configuration of the operating and nozzle cap nuts shall comply with the requirements of the local fire department. See Appendix "B" for model and manufacturer of fire hydrant. No substitutions will be permitted.

F. Gate Valve and Tapping Gate Valve

1. Gate valve and tapping gate valve for sizes 4inch through 12inch shall be ductile iron full wall thickness body resilient-seated meeting or exceeding the requirements of ANSI/AWWA C509. The bonnet shall also be ductile iron. Gate valve and tapping gate valve shall be coated both inside and outside with resistant fusion-bonded epoxy conforming to the requirements of ANSI/AWWA C550. Unless otherwise shown on the Contract Drawings, the gate valve shall have mechanical joint connections and O-ring seals, and the tapping gate valve shall have a mechanical joint by flange joint connection and O-ring seals. The flanged joint shall meet the requirements of MSS SP-60. Gate valve and tapping gate valve shall be nut operated and non-rising stem. A clockwise torque shall be required to open the valves. Valves shall be rated for 250 psi working pressure, 500 psi hydrostatic test pressure. The gate valve and tapping gate valve shall be one of the following. No substitutions will be permitted.

   Model No. A-USP2 for gate valve and Model No. T-USP2 for tapping gate valve as manufactured by United States Pipe Valve and Hydrant Division of Decatur, IL

   Model No. 4067-01 for gate valve and Model No. 4751-01 for tapping gate valve as manufactured by M&H Valve Company of Anniston, AL

   Model No. A-2362 for gate valve and Model No. T-2362 for tapping gate valve as manufactured by Mueller Company Water Products Division of Decatur, IL

   Model No. 8571(DB) for gate valve and Model No. 8590(DB) for tapping gate valve as manufactured by Kennedy Valve Company of Elmira, NY

2. Gate valve for sizes 14" and 16" shall be ductile iron reduced wall body resilient-seated meeting or exceeding the requirements of ANSI/AWWA C515. Gate valve shall be coated both inside and outside with resistant fusion-bonded epoxy conforming to the requirements of ANSI/AWWA C550. Install the gate valve in a vertical orientation. The gate valve shall be furnished with nut operated, non-rising stem, mechanical joint connections, and O-ring seals. A clockwise torque shall be required to open the gate valve. Gate valve shall be rated for 200 psi working pressure, 400 psi hydrostatic test pressure. Manufacturer of the gate valve shall be one of the following. No substitutions will be permitted.

   Model No. USP1 as manufactured by United States Pipe Valve and Hydrant Division of Decatur, IL

   Model No. 4067-01 as manufactured by M&H Valve Company of Anniston, AL

Model No. A-2361 as manufactured by Mueller Company Water Products Division of Decatur, IL

Model No. KS-RW/2638;7571SS as manufactured by Kennedy Valve Company of Elmira, NY

3. Indicator Post Gate Valve and Indicator Post

a. Indicator post gate valve for sizes 4inch through 12inch shall be ductile iron full wall thickness body resilient-seated meeting or exceeding the requirements of ANSI/AWWA C509. The bonnet and stuffing box shall also be ductile iron. Indicator post gate valve shall be coated both inside and outside with resistant fusion-bonded epoxy conforming to the requirements of ANSI/AWWA C550. Unless otherwise shown on the Contract Drawings, the indicator post gate valve shall have mechanical joint connections and O-ring seals. Indicator post gate valve shall be nut operated and non-rising stem. A clockwise torque shall be required to open the valve. Indicator post gate valve shall be rated for 250 psi working pressure, 500 psi hydrostatic test pressure. The indicator post gate valve shall be one of the following. No substitutions will be permitted.

Model No. P-2362 as manufactured by Mueller Company Water Products Division of Decatur, IL

Model No. P-USP2 as manufactured by United States Pipe Valve and Hydrant Division of Decatur, IL

Model No. 4067-01P as manufactured by M&H Valve Company of Anniston, AL

Model No. 8071-P(DB) as manufactured by Kennedy Valve Company of Elmira, NY

b. Indicator post shall be Model No. A-20806 as manufactured by Mueller Company Water Products Division of Decatur, IL, Model No. 2945A as manufactured by Kennedy Valve Company of Elmira, NY, or approved equal. Plainly mark the direction of operation with an arrow cast on the head of the post. Furnish lock with breakable hasp. Color of indicator post shall be red.

G. Valve Box and Valve Skirt

Valve box and valve skirt shall be of the type shown on the Contract Drawings and shall be fabricated of ASTM A48, Class 35B cast iron. Manhole cover for valve skirt shall be cast iron (ASTM A48, Class 35B) or ductile iron (ASTM A536, Grade 65-45-12 or Grade 80-55-06) as shown on the Contract Drawings. Ductile iron manhole covers shall bear the letters "D.I." in a clearly visible manner on the upper surface.

H. Tapping Sleeve

1. For wet tap to an existing ductile iron pipe, the tapping sleeve shall be stainless steel conforming to ASTM A240; Type 304L and meeting or exceeding the requirements of ANSI/AWWA C223. Tapping sleeve shall be furnished with stainless steel flanged joint for the tapping gate valve. Manufacturer of the tapping sleeve shall be one of the following. No substitutions will be permitted.

United States Pipe Valve and Hydrant Division of Decatur, IL

Cascade Waterworks Manufacturing Company of Yorkville, IL

Romac Industries, Inc. of Bothell, WA

Mueller Company Water Products Division of Decatur, IL

2. For wet tap to an existing cast iron pipe, the tapping sleeve shall be full wall thickness body ductile iron (ASTM A536, Grade 65-45-12) mechanical joint. Tapping sleeve shall be furnished with ductile iron flanged joint for the tapping gate valve. Manufacturer of the tapping sleeve shall be one of the following. No substitutions will be permitted.

   United States Pipe Valve and Hydrant Division of Decatur, IL

   M&H Valve Company of Anniston, AL

   Mueller Company Water Products Division of Decatur, IL

I. Crushed Stone for Ductile Iron Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with Section 02231 entitled "Aggregate Base Course".

J. Fire Hydrant Fender and Pipe Guard

1. Size and weight of fire hydrant fender and pipe guard shall be as shown on the Contract Drawings.
2. Concrete for footing and pipe fill shall be Portland cement concrete conforming to Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" or Section 03302 entitled "PORTLAND CEMENT CONCRETE, SHORT FORM".
3. Color of fire hydrant fender or pipe guard shall be yellow.

K. Paint for Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances

"Bitumastic 50", as manufactured by Carboline Company of St. Louis, MO or approved equal.

L. Paint for Fire Hydrant Fender and Pipe Guard

The prime (or first) coat shall be "Carbomastic 15 LO" and the finish (or second) coat shall be "Carboline 133 HB", satin finish, aliphatic polyurethane, both as manufactured by the Carboline Company of St. Louis, MO, or approved equal. Prime and finish coats shall be products of same manufacturer.

M. Polyethylene Encasement for Ductile Iron Pipe, Fittings and Appurtenances

ANSI/AWWA C105, Sec. A21.5, linear low-density (0.008 inch or 8 mil thickness) or high density, cross-laminated (0.004 inch or 4 mil thickness) polyethylene film. Color of polyethylene encasement shall be its natural color, including white and black, or black (weather resistant) containing not less than 2 percent carbon black with an average particle diameter of 50 millimeters or less. A minimum of 2 percent of a hindered-amine ultraviolet inhibitor is required in any natural or colored film except black film containing 2 percent or more carbon black.

PART 3. EXECUTION

3.01 VERIFICATION OF EXISTING UTILITIES

Where a pipe crosses an existing utility, as shown on the Contract Drawings, excavate a test pit or perform other exploratory methods as approved by the Engineer to verify the elevation and horizontal location at no additional cost to the Authority.

3.02 INSTALLATION

A. Operation of Existing Valves

Unless directed by the Engineer, do not operate existing valves.

B. Ductile Iron Pipe, Fittings, Gate Valves, Fire Hydrants and Appurtenances

1. Perform trench excavation in accordance with the requirements of Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" to the alignment and grades shown on the Contract Drawings. Unless otherwise shown on the Contract Drawings, the top of ductile iron pipe, fittings, gate valves, and appurtenances shall have a minimum cover of four feet.

2. As approved by the Engineer, dewater trench if groundwater is encountered. Maintain the groundwater level as required to place and compact the crushed stone bedding material and below the bottom of the ductile iron pipe's bell. Do not install the ductile iron pipe and appurtenances if the groundwater level in the trench rises above the bottom of the bell.

3. Notify the Engineer if an obstruction that is not shown on the Contract Drawings is encountered and interferes with the installation of ductile iron pipe or appurtenances. Do not continue with installation of ductile iron pipe or appurtenances until directed by the Engineer.

4. If using the Tablet Method as specified in Section 4.4 of ANSI/AWWA C651 to disinfect the installation, prior to placing ductile iron pipe in the trench, place calcium hypochlorite granules or tablets (5 gram calcium hypochlorite) at upstream end of the ductile iron pipe. Secure calcium hypochlorite tablets to the top of joint in the ductile iron pipe with a food grade adhesive. Additionally, secure one calcium hypochlorite tablet in the fire hydrant and the lateral pipe connecting to the fire hydrant. Ensure that installation is kept dry and clean.

5. Immediately prior to placing in trench, inspect all ductile iron pipe, fittings, gate valves, fire hydrants, and appurtenances in the presence of the Engineer to verify that they are internally clean and free of damage to the materials, linings and coatings. Remove and replace damaged ductile iron pipe, fittings, gate valves, fire hydrants, and appurtenances at no additional cost to the Authority.

6. Notify the Engineer when crushed stone bedding material is delivered to the construction site so the Engineer may sample and test. Do not place stone until Engineer has approved it for use.

7. After Engineer's approval of the delivered crushed stone material, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that ductile iron pipe laid on same will be at proper grade and alignment. Make suitable excavations for ductile iron pipe bells so that the bottom reaction and support are confined to the ductile iron pipe barrel. After installing the ductile iron pipe on the compacted crushed stone bedding material, place and compact additional crushed stone bedding material to the dimensions as shown the Contract Drawings.

8. Install ductile iron pipe, fittings, gate valves, fire hydrants, and appurtenances in accordance with ANSI/AWWA C600 and Section 4 of ANSI/AWWA C651.

9. When lowering the ductile iron pipe, fittings, gate valves, fire hydrants, and appurtenances into the trench and joining the units, ensure that the interior of the ductile iron pipe, fittings, gate valves, fire hydrants, and appurtenances remain clean.

10. Perform backfilling in accordance with the requirements of Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING". Unless otherwise approved by the Engineer, do not backfill around the ductile iron pipe joints, fittings, gate valves, and fire hydrants until after performing the hydrostatic testing as specified in 3.05 A. Once the hydrostatic testing is completed and approved by the Engineer, backfill around the gate valves and fire hydrants to the required grade.

11. At the conclusion of any Work period, or if Work is interrupted for any reason, close any opening in the ductile iron pipe with a watertight cap with a venting mechanism. Prior to removing the watertight cap, release any trapped air or water and dewater the trench.

C. Polyethylene Encasement

1. Install polyethylene encasement in accordance with any of the installation methods in accordance with Section 4.4 of ANSI/AWWA C105.

2. Thoroughly clean the surface of the ductile iron pipe, fittings and appurtenances prior to installation of the polyethylene encasement.

3. Fit the polyethylene encasement to the contour of the ductile iron pipe to ensure a snug, but not tight, fit. In the case of fittings and appurtenances, provide sufficient slack in contouring to prevent stretching or damage to the polyethylene encasement during backfilling of the trench.

4. Secure overlaps and ends with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place and ensure that soil does not get in between the ductile iron pipe, fittings and appurtenances and the polyethylene encasement

D. Restraining Joints, Fittings, Gate Valves, Fire Hydrants and Appurtenances

1. Restrain ductile iron pipe, fittings, gate valves, fire hydrants and appurtenances as required and in accordance with the manufacturer's written instructions. Use only the ductile iron pipe manufacturer's approved joint restraint system.

2. Where joint restraint under 3.02 D.1 is not possible, furnish and install bands and rods, as approved by the Engineer.

E. Fire Hydrant

1. Install fire hydrant as shown on the Contract Drawings and orient hydrant nozzles so that they do not point directly at hydrant fenders or pipe guards, walls, or other obstructions.

2. Prior to pouring concrete foundation, wrap and secure the polyethylene encasement around the base of the fire hydrant. Ensure that the fire hydrant drain is kept clear.

3. Following the hydrostatic testing as specified in 3.05 A, perform the following tests to ensure that the fire hydrant is properly installed and to check for leakage at the fire hydrant's flanges, outlet nozzles and O-rings around the stem:

   a. Connect a pressure pump to one of the fire hydrant's hose nozzles. Open the fire hydrant's main valve a few turns and allow the barrel to fill until the water is level with the bottom of the other outlet (hose or pumper) nozzle. After all air is expelled, replace and tighten the outlet (hose or pumper) nozzle cap. Completely open the fire hydrant's main valve. Close the gate valve located in the lateral pipe connecting to fire hydrant. Subject the fire hydrant to a pressure of 200 psi and check for leakage. If necessary, repair or replace the fire hydrant as approved by the Engineer and repeat the test.

   b. Assist the Engineer to determine that the residual water in the barrel of the fire hydrants properly drains. Close the fire hydrant main valve and remove one outlet nozzle cap. The Engineer will place the palm of one hand over the outlet nozzle opening to ensure that the residual water in the barrel of the fire hydrant properly drains such that a noticeable suction is felt. If in the opinion of the Engineer, the residual water does not properly drain, then remove and inspect the drain valve assembly to determine if it is clogged. If the drain valve assembly is not clogged, then excavate around the outside and the shoe of the fire hydrant and ensure that the drain outlet is clear and that the fire hydrant is installed as shown on the Contract Drawings.

4. Remove and relocate existing fire hydrant if shown on the Contract Drawings. Exercise care while removing and relocating the existing fire hydrant. Repair or replace any existing fire hydrant that is damaged during the performance of the Work, as approved by the Engineer, at no additional cost to the Authority. After the fire hydrant is installed, perform tests as specified in 3.02 E.4.

F. Wet Tap

1. Prior to installing tapping sleeve, thoroughly clean the exterior surface of the existing pipe, and lightly dust the interior surface of the tapping sleeve with calcium hypochlorite powder.

2. Where wet tap is to be performed on existing pipes encased in polyethylene, apply two or three wraps of polyethylene adhesive tape completely around the pipe prior to mounting the tapping machine and chain. After the wet tap is completed, inspect the polyethylene for damage and repair if needed.

G. Painting

1. Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances

a. Before backfilling, and prior to installing any polyethylene encasement, apply two heavy brush coats of paint specified in 2.01 K to all rods, bands, nuts, bolts, washers and other appurtenances.

b. Apply two heavy brush coats of paint specified in 2.01 K to appurtenances installed in a valve chamber.

2. Fire Hydrant Fender and Pipe Guard

a. Prior to painting, clean all surfaces to be painted to the requirements of SSPC SP-3.

b. Paint fire hydrant fender and pipe guard with prime and finish coats of paints specified in 2.01 L.

3.03 PROTECTION

A. Do not damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing and other activities.

B. Where pipe is damaged or displaced, take remedial measures as approved by the Engineer including, but not limited to, retesting of joints, relaying pipe or replacing pipe. Perform all such remedial measures at no additional cost to the Authority.

3:04 DISINFECTION; FLUSHING AND SAMPLING

A. Disinfect and flush the installation in accordance with ANSI/AWWA C651, except that liquid chlorine shall not be used.

B. Upon completion of the retention period required for disinfection, thoroughly flush the installation before it is connected to the existing system or placed in service. Discontinue flushing when the chlorine concentration of the water is acceptable for domestic use and the color of the water is clear. In the case of a pipe that is intended to supply water for the purpose of fire protection of a building or structure, prior to connecting the pipe to the building's or structure's internal piping, thoroughly flush the pipe. Ensure that the following minimum flow rate, which conforms to NFPA 24; Paragraph 10.10.2.1, is achieved in the pipe during flushing operation:

Pipe Size (Inches)	Flow Rate (Gallons per Minute)
4	390
6	880
8	1560
10	2440
12	3520

C. Dispose of the chlorinated water in conformance with all Federal, State and Municipal laws, ordinances, rules and regulations. If there is any possibility that the chlorinated water being discharged will cause damage to the environment, apply a neutralizing chemical to the chlorinated water to reduce the residual chlorine remaining in the water.

D. After final flushing, the approved independent testing laboratory shall sample, test and certify the water for conformance with the purity standards of the United States Environmental Protection Agency and the Federal Clean Water Act Health Standards. No installation will be approved without such certification.

3.05 FIELD TESTS

A. Hydrostatic Testing

Warning: The testing methods described below are specific for water pressure testing. Do not use these procedures for air-pressure testing because of the serious safety hazards involved.

1. After installing the ductile iron pipe, fittings, gate valves, fire hydrants and appurtenances, including backfill, but prior to final connection to the existing system, conduct in the presence of the Engineer the hydrostatic testing in accordance with ANSI/AWWA C600 and as follows:

   a. Furnish all equipment required to perform the hydrostatic testing.

   b. The test pressure for the hydrostatic testing shall be not less than 200 psi or 50 psi in excess of maximum static or working pressure as required by the Engineer, whichever is greater. Additionally, the test pressure shall not vary by more than ±5 psi for the duration of the hydrostatic testing. No installation will be approved if the test pressure varies by more than 5 psi for the duration of the hydrostatic testing.

   c. The hydrostatic testing shall be of at least a 2-hour duration.

d. Before applying the test pressure, completely expel air from the section of the installation that will be subjected to the hydrostatic testing. If necessary, install corporation cocks so that the air can be expelled as the installation is being filled with water. After all the air has been expelled, close the corporation cocks and apply the test pressure. At the conclusion of the hydrostatic testing, remove and plug the corporation cocks.

e. Gradually increase the pressure to achieve the required test pressure. Once the test pressure is achieved, allow the system to stabilize. At this time, do not operate gate valves by either opening or closing such that a differential pressure above the rated pressure of the gate valve would result and possibly damage the gate valve.

f. Once the test pressure is stable, the Engineer will carefully inspect all exposed ductile iron pipe joints, fittings, gate valves, fire hydrants and appurtenances during the hydrostatic testing. As approved by the Engineer, repair or replace any damaged or defective ductile iron pipe, fittings, gate valves, fire hydrants and appurtenances, and any visible leaks, that are discovered during the hydrostatic testing at no additional cost to the Authority, and repeat the hydrostatic testing to the satisfaction of the Engineer.

g. No installation will be approved if during the duration of the hydrostatic testing, the quantity of water that must be added exceeds the quantity as determined by the following formula:

$$L = \frac{SD\sqrt{p}}{133{,}200}$$

Where:

L = the allowable quantity of water, in gallons per hour

S = the length of pipe tested, in feet

D = the nominal diameter of the pipe, in inches

p = the average test pressure during the hydrostatic testing, in pounds per square inch (gauge)

If the quantity of water exceeds the rate as determined in above, locate the problem and repair as approved by the Engineer. After the repair is completed, repeat the hydrostatic testing to the satisfaction of the Engineer.

END OF SECTION

SECTION 02662

EXTERIOR WATER SUPPLY SYSTEM FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY FACILITIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - General Provisions:

A. Catalog Cuts

Submit catalog cut or shop drawing for: ductile iron pipe, polyethylene encasement, fittings, pipe restraint system, fire hydrant, tapping sleeve, gate valve, tapping gate valve, indicator post gate valve, indicator post, copper tubing and fitting, valve box, valve skirt (including manhole cover), fire hydrant fender or pipe guard, and paints including manufacturer's installation instructions.[This requirement is already specified]. Include manufacturer's documentation certifying that the product complies with the requirements of this Section. In the case of the fire hydrant, ensure that the size and thread configuration for the pumper nozzle [is already specified] and hose nozzle,(as well as the size and configuration of the operating and nozzle cap nuts is clearly stated.

B. Samples

Submit to the Chief of Materials Engineering of the Materials Engineering Unit, which is located at the Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data for gradation and composition of the crushed stone for pipe bedding, together with one 75-pound representative sample of the material in accordance with 1.03 B.

C. Certificates

Submit certificate from the polyethylene encasement manufacturer certifying that the polyethylene encasement complies with the requirements specified in this Section.

D. Construction and Installation Procedures

Submit plans, methods, procedures, and types of equipment as applicable for:

1. Verifying location of existing utilities specified in 3.01.
2. Prevention of accumulation of groundwater specified in 3.02 B.2.
3. Disinfection, flushing and sampling as specified in 3.04n.
4. Hydrostatic testing specified in 3.05.

E. Qualifications

1. Submit resume indicating name, address, and previous work experience of the entity performing the Work of this Section, prior to performing the Work of this Section.

2. Submit the name, address and qualifications of the independent testing laboratory to be employed to sample, test and certify the water for conformance to purity standards.

F. Inspection Reports

Submit results of field tests specified in 3.04 and 3.05.

END OF APPENDIX "A"

SECTION 02662

EXTERIOR WATER SUPPLY SYSTEM FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY FACILITIES

APPENDIX "B" - FIRE HYDRANTS

Facility	Model	Direction of Opening	Fire Hydrant Colors		
			Barrel	Bonnet	Outlet Caps
Port Newark	Metropolitan/M-94 (1)	Left	Yellow	Green	Yellow
Elizabeth Port Authority Marine Terminal	Metropolitan/M-94 (1)	Left	Red	Silver	Red
Auto Marine Terminal	Metropolitan/M-94 (1)	Left	Yellow	Green	Yellow
Howland Hook Marine Terminal	Metropolitan/M-94 (1)	Right	Black	Silver	Black
Brooklyn Marine Terminal	Metropolitan/M-94 (1)	Right	Black	Silver	Black
Newark Liberty International Airport (Standard Pressure)	Metropolitan/M-94 (1)	Left	Yellow	Green	Yellow
Newark Liberty International Airport (High Pressure)	Metropolitan/M-94 (1)	Left	Red	Red	Red
John F. Kennedy International Airport (Standard Pressure)	Metropolitan/M-94 (1)	Right	Black	Silver	Black
John F. Kennedy International Airport (Intermediate Pressure)	Metropolitan/M-94 (1)	Right	Black	Yellow	Yellow
John F. Kennedy International Airport (High Pressure)	Metropolitan/M-94 (1)	Right	Yellow	Yellow	Yellow
LaGuardia Airport (Standard Pressure)	Metropolitan/M-94 (1)	Right	Black	Silver	Black
LaGuardia Airport (High Pressure)	Metropolitan/M-94 (1)	Right	Yellow	Yellow	Yellow
Teterboro Airport	Metropolitan/M-94 (1)	Right	Red	Red	Red
Goethals and Bayonne Bridges and Outerbridge Crossing for NY Side Only	Metropolitan/M-94 (1)	Left	Red	Red	Yellow

(1) As manufactured by United States Pipe Valve and Hydrant Division of Decatur, Illinois. No substitutions permitted?

EXTERIOR WATER SUPPLY SYSTEM FOR PORT AUTHORITY OF NEW YORK & NEW JERSEY FACILITIES

APPENDIX "B" - FIRE HYDRANTS

(CONTINUED)

Facility	Model	Direction of Opening	Colors		
			Barrel	Bonnet	Outlet Caps
George Washington Bridge	American-Darling B-84-B-5 (2)	Left	Red	Red	Red
Lincoln Tunnel (NY and NJ)	American-Darling B-84-B-5 (2)	Left	Red	Red	Red

(2) As manufactured by American Flow Control; a division of American Cast Iron Pipe Company of Birmingham, Alabama.

END OF APPENDIX "B"

DIVISION 2

SECTION 02670

BIORETENTION BASINS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the construction of the bioretention basins

B. Definition of terms shall be in accordance with ASTM C822.

1.02 SYSTEM DESCRIPTION

1.03 REFERENCES

A. The following is a list of the publications referenced in the Section:

American Association of State Highway and Transportation Officials

AASHTO M6	Standard Specification for Fine Aggregate for Hydraulic Cement Concrete
AASHTO M43	Standard Specification for Sizes of Aggregate for Road and Bridge Construction
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M105	Gray Iron Castings

American Society of Testing and Materials (ASTM)

ASTM A48	Standard Specification for Gray Iron Castings
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C150	Specification for Portland Cement
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C595M	Standard Specification for Blended Hydraulic Cements
ASTM C822	Terminology Relating to Concrete Pipe and Related Products
ASTM C857	Standard Practice for Minimum Structural Design Loading for

	Underground Precast Concrete Utility Structures
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures
ASTM C990-91	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM F949	Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Bioretention basins use vegetation, specific soil mixtures, and aggregate layers to filter stormwater and are highly susceptible to contamination by sediment. Therefore installation of vegetation immediately following the construction of each facility is essential.

B. Design of lifting devices for precast structures shall conform to ASTM C913.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Construct bioretention basins only after all contributing drainage areas are permanently stabilized and vegetation are established.

B. Mixing or placing planting bed soil shall not be allowed if the area receiving the planting bed soil is frozen, excessively wet or saturated or has been subject to more than ½ inch of precipitation within 48 hours prior to mixing or placement.

C. The Engineer shall have final authority to determine if wet or saturated conditions exist.

1.06 QUALITY ASSURANCE

A. Soil placement and consolidation shall not occur when the planting bed soil is excessively wet.

B. Outlet control structures for the bioretention basins shall be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no additional cost to the Authority.

C. Mixing or placing planting bed soil shall not be allowed if the area receiving the planting bed soil is frozen, excessively wet or saturated or has been subject to more than ½ inch of precipitation within 48 hours prior to mixing or placement. The Engineer shall have final authority to determine if wet or saturated conditions exist.

D. The Contractor shall not place planting bed soil until the soil mix delivery ticket(s) have been reviewed and accepted by the Engineer.

E. The Contractor shall provide the Engineer the opportunity to inspect the excavation prior to placement of any material within the excavation.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with outlet control structure manufacturer's instructions for unloading, storing and moving precast structures.

B. Planting Bed soil shall be protected from all sources of additional moisture at the Supplier's site, in transport to the project site and at the project site until it is placed in the bioretention basin.

C. Each outlet control structure shall be clearly marked by indentation or waterproof paint to indicate the date of manufacture, manufacturer and identifying symbol and/ or number to indicate its intended use.

1.08 GUARANTEES

1.09 MAINTENANCE

1.10 SUBMITTALS

A. SEE Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal:

A. Bioretention Basins shall be as shown on the contract drawings.

2.02 MATERIALS

A. Planting Bed Soil

1. The planting soil bed shall consist of the following mix by weight, 85 to 95% sands, with no more than 25% of the sands classified as fine or very fine sands, no more than 15% silt and clay with 2% to 5% clay content. The entire mix shall be amended with 3 to 7% organics. The pH of the planting bed soil should range between 5.5 to 6.5.

2. The soil mix and pre-installation permeability rate of the soil bed material must be certified by Professional Engineer licensed by the State of New Jersey. A licensed Professional Engineer must also be present, and perform the required in-situ soil testing, during any on-site material mixing and during installation of the planting bed.

B. Sand Layer

1. The sand layer must have a minimum thickness of 6 inches and consist of clean medium aggregate concrete sand conforming to AASHTO M-6/ ASTM C33.

2. The sand layer material must be tested and certified by a Professional Engineer licensed in the State of New Jersey.

C. Gravel Layer

1. The gravel layer will have sufficient thickness to provide a minimum of 3 inches of cover over and under the underdrain pipe and shall consist of 0.5 to 1.5 inch clean broken stone or pea gravel conforming to AASHTO M43.

D. Underdrain Piping

1. Underdrain pipe shall be 6 in. diameter thermoplastic pipe. Polyvinyl chloride Profile Wall Drain Pipe (PPWP) meeting ASTM F949 or Corrugated Polyethylene Drainage Pipe (CPP-S) meeting AASHTO M252, Type S and Type SP. Perforated pipe shall have slotted perforations with an opening area of 1 in 2/ft to 1.5 in 2/ft.

E. Seed Mixture

1. The seed mixture used in the bioretention basins will consist of the following:

Kind of Seed	Min. Purity %	Min. Germination %	Percent of Total Weight of Mixture
Blackwell Switchgrass (Panicum virgatum)	95	85	25
Virginia Wildrye (Elymus Virginicus)	95	85	25
Red Top (Agrostis alba)	95	85	25
Annual Rye (Lolium multiflorum)	95	85	25

F. Concrete

1. Concrete for the outlet control structure shall conform to ASTM C857 and C478. Cement shall be Type I, II or III Portland cement conforming to ASTM C150. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20-44 (MS18) loading requirements as determined by a Licensed Professional Engineer. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has obtained a compressive strength of 4,000 psi or other designated suitable handling strength.

G. Joints

1. Sections shall have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C990.

H. Brick or Masonry

1. Brick or masonry used to build the manhole frame to grade shall conform to ASTM C32 or ASTM C139 and shall be installed in accordance with Section 02721.

I. Frames, Grates and Covers

1. The frames and cover for the outlet control structure shall be in accordance with ASTM A48, CL. 35B and AASHTO M105. The casting and frame shall be equivalent to Campbell Foundry Pattern 3425.

J. Crushed Stone Bedding

1. Crushed limestone, gneiss, trap rock or recycled Portland cement aggregate conforming to ASTM C33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of Section 02231 entitled "AGGREGATE BASE COURSE".

K. Connection between Structure and Pipe

1. Pipe openings shall be sized to accept pipes of the specified size (s) and materials (s), and shall be sealed by the Contractor with a hydraulic cement conforming to ASTM C595M.

2.03 CONSTRUCTION FEATURES

2.04 ACCESSORIES

2.05 FABRICATION

A. Manufacture of outlet control structures shall conform to ASTM C913.

2.06 SHOP FINISHING

2.07 SHOP TESTING

PART 3. EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

A. Construct bioretention basins only after all contributing drainage areas are permanently stabilized and vegetation has been established.

B. Do not stockpile materials nor store equipment in these areas.

C. Do not construct bioretention basins in areas previously used as erosion and sediment control facilities.

3.03 INSTALLATION

A. Excavation and Installation of Bioretention Basin

1. Excavate for bioretention basin in accordance with SECTION 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Contract Drawings. Provide clearance around the excavation as required for construction.
2. If groundwater is encountered, prevent accumulation of water in excavations by methods approved by the engineer. The bioretention basins shall be constructed in a dry excavation.
3. The liner for the bioretention basins shall be constructed in accordance with Section 02273 entitled" GEOSYNTHETIC CLAY LINER LAMINATED TO TEXTURED HIGH-DENSITY POLYETHLENE (HDPE) GEOMEMBRANE" in the project specifications.
4. Heavy equipment shall not operate within the bioretention basin once the backfilling operation has begun to avoid compaction of the soil planting bed. Use methods of excavation that minimize the compaction of the planting soil bed. Use excavators and backhoes operating on the adjacent ground. If the bottom width of the excavated area is greater than 15 ft, wide-track or marsh-track equipment, or light equipment with turf-type tires may be to place fill materials. Do not use equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires.
5. Planting soil bed to be placed in 12-18 inch lifts.

B. Support and Backfilling

1. The outlet control structure for the bioretention basins shall be supported at proper grade and alignment on a 6-inch (minimum thickness) crushed stone bedding or other support system as shown on the Contract Drawings.

2. Backfill the excavations for the bioretention basins in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

C. Installation of Outlet Control Structure

1. To ensure safety, the outlet control structure shall be lifted only at the lifting points so designed by the Engineer.
2. When lowering the outlet control structure into the excavation and joining pipe to the structure, take precautions to ensure that the pipes and structure remain clean.
3. Set the outlet control structure so that it is fully bearing on crushed stone bedding compacted in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" or set on another support system as shown on the Contract Drawings.
4. For multiple section structures, lower and set the base section before placing additional sections. Ensure joint integrity by removing all foreign material from joint surfaces and verify the sealing materials are place properly. Avoid misalignments by using guide devices affixed to the lower section or as otherwise recommended by the manufacturer.
5. Verify that outlet control structures installed satisfy required alignment and grade.
6. Remove knockout or core the structure for pipe so as not to create an opening in excess of that required. Fill resultant annular space with mortar cement in accordance with manufacturer's recommendations.
7. Cut pipe to finish flush with interior of the outlet control structure.

D. Installation of Frame and Cover or Grate

1. Set frame using mortar and masonry as shown on the Contract Drawings. Radially laid brick shall have ¼-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar cement and completely fill al joints. When more than one course of concrete brick is requires, stagger vertical joints.
2. Set frame and grate flush with finished grade as shown on the Contract Drawings.
3. Manhole frames and covers shall be fitted together and match-marked to avoid rocking of covers and grates. All castings shall be set firm and snug and shall not rattle.

3.04 FIELD QUALITY CONTROL

3.05 ADJUSTING

3.06 PROTECTING

END OF SECTION

SECTION 02670

BIORETENTION BASINS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirement of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

A. Shop Drawings

1. Shop drawings of outlet control structures.

B. Catalog Cuts

1. Catalog cuts of underdrain pipe and fittings.
2. Catalog cuts of gaskets for joints in outlet control structure, including manufacturer's installation instructions.

C. Submittals for Planting Bed soil:

1. Grain size analysis of the sand used in the planting bed soil.
2. Organic content test results for the planting bed soil mix. Organic content test shall be performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, Loss-On-Ignition Organic Matter Method.
3. Manufacturer's Certificate(s) of Compliance accompanying the test results from the Supplier of the planting bed soil.
4. A description of the equipment and methods used to mix the planting bed soil.

END OF APPENDIX 'A"

DIVISION 2

SECTION 02711

SUBDRAINAGE SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for perforated high density polyethylene pipe (HDPE) and non-perforated high density polyethylene pipe (HDPE) subdrainage systems.

B. Definition of terms relating to plastic pipe shall be in accordance with ASTM F412.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 288	Standard Specification for Geotextiles

American Society for Testing and Materials (ASTM)

ASTM C 33	Concrete Aggregates
ASTM F 2306	12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings to Gravity-Flow Storm Sewer and Subsurface Drainage Applications
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
ASTM F 2648	2 to 60 Inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications
ASTM D 3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 412	Standard Terminology Relating to Plastic Piping Systems
ASTM F 477	Elastomeric Seals for Joining Plastic Pipe

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with piping systems of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Plastic pipe that is stored at the construction site shall remain covered, in a manner approved by the Engineer, until pipe installation is performed.

C. Care shall be taken when storing pipe and appurtenances so as not to damage Authority or other public or private property and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

See Appendix "A"

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Perforated High Density Polyethylene Pipe.

1. Mega Green ST, manufactured by Hancor, Inc., Findlay, OH.
2. Mega Green ST, manufactured by Advanced Drainage Systems, Inc., Hillard, OH.
3. Approved Equal.

B. Non-perforated High Density Polyethylene Pipe

1. Mega Green WT, manufactured by Hancor, Inc., Findlay, OH.
2. Mega Green WT, manufactured by Advanced Drainage Systems, Inc., Hillard, OH.
3. Approved Equal.

2.02 MATERIALS

Use any of the pipe systems specified below unless otherwise shown on the Contract Drawings.

A. Perforated High Density Polyethylene Pipe.

1. Pipes conform to ASTM F 2648
2. Gaskets conform to ASTM F 477
3. Fittings conform to ASTM F 2306

B. Non-perforated High Density Polyethylene Pipe.

1. Pipes conform to ASTM F 2648
2. Gaskets conform to ASTM F 477
3. Fittings conform to ASTM F 2306
4. Watertight conform to ASTM D 3212

C. Geotextile Wrap (sock): Pipe with circular perforations, and pipe with slotted perforations greater than 1/16" least dimension, shall be furnished with manufacturer's recommended geotextile wrap (sock) to prevent entry of aggregate through the perforations.

D. Geotextile (fabric) shall meet the physical requirements of Class 1 for Drainage applications of AASHTO M 288 and shall be in accordance with Section 02274 entitled "GEOTEXTILES."

E. Washed Aggregate shall be crushed stone conforming to ASTM C33 size No. 6, 67, 7 or an approved equal with maximum size of 25 mm (1") and minimum size of 2.36 mm (No. 8).

PART 3. EXECUTION

3.01 EXAMINATION

Where the subdrain is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Contract Drawings.
2. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer.

B. Subdrain Installation

1. Prior to the start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or grade board setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

2. Place geotextile (fabric) in trench and then place washed aggregate in maximum 6 inch lifts to the invert elevations shown on the Contract Drawings. Compact each lift of washed aggregate with two passes of a vibrating pad compactor.

3. Immediately prior to placement in the trench, all pipe shall be inspected in the presence of the Engineer to verify that it is internally clean and free of damage. Damaged units shall be removed from the construction site and replaced to the satisfaction of the Engineer and at no additional cost to the Authority.

4. Lay pipe with bell or grooved end up grade.

5. When lowering pipe into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

6. Make up pipe joints in accordance with the manufacturer's instructions. Do not cover pipe until the Engineer has approved the installation.

7. Place the balance of the washed aggregate in maximum 6-inch lifts to the elevation shown on the Contract Drawings. Compact each lift with two passes of a vibrating pad compactor.

8. Complete geotextile (fabric) encasement of the washed aggregate as shown on the Contract Drawings and in accordance with the Section 02274 entitled "GEOTEXTILES."

9. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or interrupted for any reason.

C. Pipe Installation

Installation of HDPE and shall be in accordance with the applicable provisions of ASTM D 2321.

3.03 PROTECTION

A. Care shall be taken not to damage or displace installed pipes during construction.

B. Where pipe is damaged or displaced, replace or take remedial measures as directed by the Engineer at no additional cost to the Authority.

END OF SECTION

SECTION 02711

SUBDRAINAGE SYSTEM

APPENDIX "A"

A. Submit certificates from manufacturers of the following items certifying that the following materials comply with the requirements specified in this Section:

1. Perforated High Density Polyethylene Pipe (HDPE)
2. Non-perforated High Density Polyethylene Pipe (HDPE)
3. Geotextile (Fabric)

B. Submit to the Chief Materials Engineer, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the washed aggregate proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag which shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with: Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

C. Submit Catalog Cuts of pipes and geotextile (fabric) for the Engineer's approval.

D. Submit for Engineer's approval methods for prevention of accumulation of groundwater and alternate methods of line and grade control where applicable.

E. Submit "As-Built" drawings in accordance with Section of Division 1 entitled "Utility Record Drawings."

END OF APPENDIX "A"

DIVISION 2

SECTION 02720

MANHOLES AND DRAINAGE STRUCTURES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for precast and cast-in-place concrete manholes and drainage structures.

B. Definition of terms shall be in accordance with ASTM C 822.

1.02 REFERENCES

A. The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 318	Building Code Requirements for Structural Concrete and Commentary.
	American Society for Testing and Materials (ASTM)
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 536	Specification for Ductile Iron Castings.
ASTM B26	Specification for Aluminum-Alloy Sand Castings.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 55	Specification for Concrete Building Brick.
ASTM C 117	Test Method for Materials Finer than 75μm (No. 200) Sieve in Mineral Aggregates by Washing.
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C 150	Specification for Portland Cement.
ASTM C 1329	Specification for Mortar Cement.
ASTM C 443	Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C 497	Test Methods for Concrete Pipe, Manhole Sections, or Tile.
ASTM C 822	Terminology Relating to Concrete Pipe and Related Products.
ASTM C 891	Practice for Installation of Underground Precast Concrete Utility Structures.

ASTM C 913	Specification for Precast Concrete Water and Wastewater Structures.
ASTM C 923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
ASTM C 990	Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.03 ENVIRONMENTAL REQUIREMENTS

Cold and hot weather requirements shall conform to the applicable requirements of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" except that in a precast plant the ambient temperature may be below 40 degrees F providing that forms and product are preheated and heat cured and protected. Temperature recording devices shall be used.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. As approved by the Engineer, the Contractor may substitute cast-in-place concrete manholes and drainage structures which conform in size and strength to the precast concrete structures shown on the Contract Drawings and as specified in this Section. As approved by the Engineer, the Contractor may also substitute precast concrete structures which conform in size and strength to the cast-in-place concrete structures shown on the Contract Drawings and as specified in this Section. Equivalent strength of substituted structures shall be based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of lifting devices for precast structures shall conform to ASTM C 913.

C. Design of joints for precast concrete structures shall conform to ASTM C 913. Unless otherwise shown on the Contract Drawings, joints shall be designed for leakage not to exceed 0.025 gallons per hour per foot of joint at 3 feet of head.

1.05 QUALITY ASSURANCE

A. Workmen shall be experienced and skilled in the fabrication and installation of precast and cast-in-place concrete manholes and drainage structures.

B. Precast concrete manholes and drainage structures, including castings, will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced, at no additional cost to the Authority.

C. Precast concrete manholes and drainage structures may be inspected by the Engineer at the place of manufacture.

D. Where manholes and drainage structures are cast-in-place, do not place concrete until the Engineer has inspected the formwork and verified that the dimensions and concrete reinforcing are in accordance with details shown on the Contract Drawings, on approved shop drawings and as specified in this Section.

E. Conform to the applicable requirements for quality assurance of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" except that, if the concrete is precast, the producer shall maintain a fully equipped testing lab and employ a Quality Control Technician to perform Quality Control Tests. Unless otherwise shown on the Contract Drawings, Quality Control Tests for precast concrete shall consist of compression tests on a minimum of two cylinders for each day's production tested in accordance with ASTM C 39 for cylinders or ASTM C 497 for drilled cores. Acceptance shall be based on the requirements of ACI 318.

F. Tolerances of dimensions, squareness, joint surfaces, reinforcement location, and thickness of slabs and walls for precast structures shall conform to ASTM C 913.

G. Castings shall be of uniform quality, free from sand holes, shrinkage cracks and other defects. Surface of the castings shall be free from burnt-on sand and shall be smooth. Bearing surfaces between grates or covers and frames shall be cast or machined with such precision that continuous, full and uniform bearing is provided throughout the perimeter area of contact. The bearing contact with the frame shall be non-rocking when in place and under the influence of traffic or other loads. Pairs of machined castings shall be match marked to facilitate subsequent identification at installation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and drainage structures.

B. Care shall be taken when storing precast concrete manholes and drainage structures to prevent damage to Authority or other public or private property, and any property so damaged shall be repaired at no additional cost to the Authority.

C. Each precast concrete structure shall be clearly marked by indentation or waterproof paint to indicate the date of manufacture, manufacturer and identifying symbols and/or numbers shown on the Contract Drawings to indicate its intended use.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal:

A. Manhole and Drainage Structure Frames, Covers and Grates

Frames, cover and grates shall be as shown on the Contract Drawings.

B. Resilient Connectors

1. NPC Inc., Milford, NH 03055.
2. Press-Seal Gasket Corporation, Fort Wayne, IN 46804.

3. A-Lok Products Inc., Tullytown, PA 19007.

2.02 MATERIALS

A. Concrete

1. Concrete including concrete mixes shall be Category VI with a minimum 28-day compressive strength of 5000 psi for precast and 4000 psi for cast-in-place concrete manholes and drainage structures in accordance with the applicable requirements of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

B. Joints

1. Unless otherwise shown on the Contract Drawings, joints shall not be permitted in manholes and drainage structures.

2. Joints between precast sections, which occur four feet or more below finished grade, shall be sealed with rubber gaskets conforming to ASTM C 443 or a preformed flexible plastic gasket as specified in 2.02 B.3.

3. Where a preformed flexible plastic gasket is shown on the Contract Drawings, joints between precast sections shall be sealed with a preformed flexible plastic gasket conforming to ASTM C 990, except that gasket size, lengths, quantity of primer and packing material shall be in accordance with the manufacturer's recommendation. Preformed flexible plastic gaskets shall be one of the following, or approved equal:

   a. "Ram-Nek", as manufactured by Henry Co., El Segundo, CA.

   b. "CONSEAL CS-102", as manufactured by the Concrete Sealants, Inc, New Carlisle, OH.

   c. "PRO-STIK", as manufactured by Press-Seal Gasket Corporation, Fort Wayne, IN.

C. Steel Reinforcement

1. Steel reinforcement shall conform to Section 03200 entitled "CONCRETE REINFORCEMENT".

2. There shall be a continuity of reinforcement at all corners of the structure.

D. Silt Buckets

1. Cast aluminum silt bucket shall be furnished and installed for all sanitary sewer manhole structures shown on the Contract Drawings and shall be fabricated of aluminum Alloy 319, conforming to ASTM B 26.

E. Frames, Grates and Covers

1. Frames shall be of the type shown on the Contract Drawings and shall be fabricated of Class 35B cast iron, conforming to ASTM A 48.

2. Covers and grates shall be of the types and materials shown on the Contract Drawings. Where cast iron is shown, manhole covers and drainage grates shall be fabricated of Class 35B cast iron, conforming to ASTM A 48. Where ductile iron is shown, manhole covers and drainage grates shall be fabricated of Grade 65-45-12, or Grade 80-55-06 ductile iron and castings, conforming to ASTM A 536 and shall bear the letters "D.I." in a clearly visible manner on the upper surface.

3. Frames, covers or grates of other materials shall be as shown on the Contract Drawings.

4. Each casting shall be identified by the name of the producing foundry, origin and date of manufacture, ASTM designation number and class of cast or ductile iron.

F. Masonry Collar for Frame

1. Concrete Building Brick: ASTM C 55.

2. Mortar Cement

ASTM C 1329, Type M.

G. Crushed Stone Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

H. Connection Between Structure and Pipe

1. Unless otherwise shown on the Contract Drawings, the opening between the wall of the structure and the wall of the pipe shall be sealed with mortar cement conforming to ASTM C 1329, Type M or a resilient connector.

2. Resilient connector shall conform to ASTM C 923. If resilient connector is not integrally cast into the wall of the structure, provide cast or cored opening of the size specified by manufacturer of the resilient connector.

2.03 FABRICATION

Manufacture of precast concrete structures shall conform to ASTM C 913.

PART 3. EXECUTION

3.01 PREPARATION

A. Ensure proper orientation of the structure to accommodate pipes.

B. Immediately prior to placement in the excavation, precast concrete structures shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be removed from the construction site and replaced, at no additional cost to the Authority. Subject to the approval of the Engineer, damaged precast concrete structures may be repaired in a manner that ensures that the structure will conform to the requirements of this Section and its intended use. Acceptance of repaired units is at the sole discretion of the Engineer.

3.02 INSTALLATION

A. Excavation and Backfill

1. Excavate for manhole or drainage structure in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to depth shown on the Contract Drawings. Provide clearance around the sidewalls of the structure as required for construction.

2. If ground water is encountered, prevent accumulation of water in excavations by methods approved by the Engineer. Manhole or drainage structure shall be placed in a dry trench.

3. Where the possibility exists of a watertight structure becoming buoyant in a flooded excavation, take necessary steps to avoid flotation of the structure.

B. Support and Backfilling

1. Manhole or drainage structure shall be supported at proper grade and alignment on crushed stone bedding or other support system, as shown on the Contract Drawings.

2. Backfill excavation for manhole or drainage structure in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

C. Installation of Precast Concrete Sructure

1. To ensure safety, precast concrete structures shall be lifted only at the lifting points so designated by the manufacturer.

2. When lowering manhole or drainage structure into the excavation and joining pipe to the structure, take precautions to ensure that the interior of the pipes and structure remains clean.

3. Set precast concrete structure so that it is fully bearing on crushed stone bedding, compacted in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" or set on other support system as shown on the Contract Drawings.

4. For multiple section structures, lower and set the base section before placing additional sections. Ensure joint integrity by removing all foreign materials from joint surfaces and verify that sealing materials are placed properly. Avoid misalignment by using guide devices affixed to the lower section or as otherwise approved by the Engineer. Joint seal material may be installed at the manufacturer's plant prior to delivering to construction site.

5. Verify that manholes and drainage structures installed satisfy required alignment and grade.

6. Remove knockout or core the structure for pipe so as not to create an opening in excess of that required. Fill resultant annular space with mortar cement or with a resilient connector installed in accordance with manufacturer's instructions.

7. Cut pipe to finish flush with interior of structure.

8. Shape inverts through manhole as shown on the Contract Drawings.

D. Installation of Cast-In-Place Concrete Structure

1. Prepare crushed stone bedding or other support system shown on the Contract Drawings, to receive the base slab as specified for precast structures in 3.02 C.3.

2. Erect forms in accordance with Section 03100 entitled "CONCRETE FORMWORK" and ensure that forms are braced against all movement.

3. Furnish and install reinforcing steel in accordance with the details shown on the Contract Drawings and in accordance with Section 03200 entitled "CONCRETE REINFORCEMENT".

4. After formwork and reinforcing steel are inspected and approved by the Engineer, place and cure concrete in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

5. Complete installation in accordance with 3.02 C above.

E. Installation of Frame and Cover or Grate

1. Set frame using mortar cement and masonry as shown on the Contract Drawings. Radially laid concrete brick shall have 1/4-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar cement and completely fill all joints. Where more than one course of concrete brick is required, stagger vertical joints.

2. Set frame and cover two inches above finished grade for manhole structure located in unpaved area. Otherwise, set frame and cover flush with finished grade.

3. Set frame and grate flush with finished grade for all catch basins or drainage inlets, unless otherwise shown on the Contract Drawings.

4. Manhole, inlet and catch basin frames, grates, and covers shall be fitted together and match-marked to avoid rocking of covers and grates. All castings shall be set firm and snug and shall not rattle.

3.03 VERTICAL ADJUSTMENT OF EXISTING STRUCTURES

A. Where shown on the Contract Drawings, adjust the elevation of existing manhole or drainage structure to finished grade.

B. Existing frame and grate or cover shall be carefully removed, cleaned of all mortar fragments to the satisfaction of the Engineer and set to the finished grade in accordance with 3.02 E.

C. When removal of an existing reinforced concrete wall is required, the concrete shall be removed so as not to damage the existing reinforcing bars. The bars shall be cleaned of all concrete to the satisfaction of the Engineer and bent into the new concrete top slab or spliced to vertical reinforcement, as shown on the Contract Drawings.

D. Bond new concrete to existing concrete in accordance with requirements specified in Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

3.04 FIELD TESTS

Field tests will be used by the Engineer to evaluate and approve cast-in-place concrete in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

3.05 PROTECTION

Protection and curing of concrete shall be in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

END OF SECTION

SECTION 02720

MANHOLES AND DRAINAGE STRUCTURES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02720A01 Shop drawings of precast concrete manholes and drainage structures and of concrete reinforcement for cast-in-place concrete manholes and drainage structures, if used;

Catalog Cuts

02720B01 Catalog cuts of frames, grates and covers.

02720B02 Catalog cuts of gaskets for joints in precast concrete manholes and drainage structures, including manufacturer's installation instructions.

02720B03 Catalog cuts of resilient connectors.

Certificates

02720E01 Submit certificate from gasket manufacturer certifying that the gaskets comply with the specified requirements and that the gaskets are compatible with the type of joint used.

Manufacturer Test Reports

02720F01 Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the crushed stone for bedding proposed for use.
1. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

Construction and Installation Procedures

02720G01 Submit plans, methods, equipment and procedures as applicable for:
1. Prevention of accumulation of groundwater as specified in 3.02.
2. Methods other than guide devices to avoid misalignment of joints during installation of precast concrete structures as specified in 3.02.
3. Methods to prevent flotation of watertight structures as specified in 3.02.

4. Installation of resilient connectors as specified in 3.02 C.6.

Calculations

02720H01 Submit design calculations prepared by a Professional Engineer, licensed in the State where the Work is being performed:

1. For substitute designs of manholes and drainage structures, submit calculations which verify that the substituted design is equivalent to the design shown on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 2

SECTION 02721

STORM DRAINAGE SYSTEM

(INFILTRATION/EXFILTRATION TESTING REQUIRED)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for exterior storm drainage systems where Infiltration/ Exfiltration testing is required.

B. Definition of terms related to Reinforced Concrete Pipe and Plastic Pipe shall be in accordance with ASTM C 822 and ASTM D 883 respectively.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

American Society for Testing and Materials International (ASTM)

ASTM A 746	Ductile Gravity Sewer Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Test Method for Material Finer Than .075mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 507	Reinforced Concrete Elliptical Culvert Storm Drain and Sewer Pipe
ASTM C 655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 822	Terminology Relating to Concrete Pipe and Related Products
ASTM C 924	Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 969	Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

ASTM C 1103	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D 883	Standard Terminology relating to Plastics
ASTM D 2321	Standard Practice for underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow application
ASTM D 3212	Standard specification for Joints for Drain and Sewer Plastic Pipes Using flexible Elastomeric Seals
ASTM F 477	Elastometric Seals (gaskets) for joining Plastic Pipe
ASTM F 2306	12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications
ASTM F 2487	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines
	American Water Works Association (AWWA)
AWWA C 104	Cement- Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with piping systems of types and sizes similar to that required under this Contract.

B. The Engineer will visually inspect the pipe upon delivery to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no additional cost to the Authority.

C. The Engineer may inspect the Pipe at the place of manufacture.

1.04 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe and appurtenances so as not to damage Authority or other public or private property; any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

Use any of the pipe sytems specified below unless otherwise shown on the Contract Drawings.

A. Reinforced Concrete Pipe

1. ASTM C 76, Class V, Wall B or Wall C for circular Reinforced Concrete Pipe, ASTM C 507, Class HE-IV for Horizontal Elliptical Pipe and Class VE-VI for Vertical Elliptical Pipe, unless otherwise shown on the Contract Drawings. Use ASTM C 150, Type II Portland cement. Pipe joints shall be tongue and groove or bell and spigot, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. In uncontaminated soil, pipe joints shall be sealed with rubber gaskets. Design of joints and physical requirements for rubber gaskets shall conform to ASTM C 443. Rubber gaskets shall be the following types of rubber gaskets, manufactured by Hamilton Kent Manufacturing Co., or approved equal:

   a. "Tylox Type C" for straight tongue and groove pipe

   b. "Tylox Superseal" for offset pipe

   c. "Tylox Type 0" for recessed pipe

3. Where pipe installation in contaminated soil is shown on the Contract Drawings, pipe joints shall be sealed with a continuous rubber ring gasket and with a preformed plastic gasket, as shown on the Contract Drawings. Plastic gasket shall conform to AASHTO M 198, except that gasket size, lengths, quantity of primer and packing material shall be in accordance with the gasket manufacturer's recommendation. Preformed flexible plastic gaskets shall be the following, or approved equal:

   a. "Ram-Nek", as manufactured by Diplomatic Marine Inc., Houston, TX

   b. "GS-79", as manufactured by General Sealants Corp., Anaheim, CA

B. Ductile Iron Pipe

1. ASTM A 746, minimum wall thickness Class 50 unless otherwise shown on the Contract Drawings, with push-on joints, and cement mortar lining, which shall be twice the standard thickness in AWWA C 104.

2. In uncontaminated soil, joints shall be sealed with continuous ring rubber gaskets conforming to AWWA C 111.

3. Where pipe installation in contaminated soil is shown on the Contract Drawings, use neoprene gaskets conforming to AWWA C 111.

4. Polyethylene Encasement for Ductile Iron Sewer Pipe: AWWA C 105, Class C polyethylene, 8-mil thickness.

C. Corrugated Polyethylene Pipe

1. ASTM F 2306, high density Polyethylene pipe, joints shall be bell and spigot and sealed with a continuous gasket.

2. Joints shall meet the requirements of ASTM D 3212.

3. Where pipes installation in uncontaminated soil is shown on the Contract Drawings, pipe joints shall be sealed with continuous ring rubber gaskets and conforming to ASTM F 477.

4. Where pipe installation in contaminated soil is shown on the Contract Drawings, pipe joints shall be sealed with neoprene gaskets and conforming to ASTM F 477.

A. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the storm drain is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with the Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" and ASTM D 2321 in the location and to the depth shown on the Contract Drawings.

2. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet for nominal diameters up to 18 inches or outside diameter plus three feet for nominal diameters in excess of 18 inches, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. The Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load such as ASTM C655 or ASTM A 746. A subtrench is defined as a trench excavated for pipe placement within a wider trench.

3. Pipe shall be laid in a dry trench. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer.

B. Pipe Support and Backfilling

1. Where concrete cradles are shown on the Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section 03301 entitled "PORTLAND CEMENT CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.

2. Where crushed stone bedding is shown on the Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for the pipe bells, where applicable so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted layer, place and compact additional bedding material in small lifts to the dimensions shown.

3. a. Reinforced Concrete Pipe and Ductile Iron Pipe

   Continue backfilling of the trench from the pipe support limits reached in 3.02 B.1 and 2 above in accordance with the Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

   b. Corrugated Polyethylene Pipe

   Place pipe embedment and backfilled in accordance with ASTM D 2321.

C. Polyethylene Encasement for Ductile Iron Pipe

1. Install polyethylene encasement on all ductile iron pipes using one of the installation methods described in AWWA C 105.

2. Pipe surface shall be totally cleaned prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or bedding material from becoming trapped between the pipe and the polyethylene encasement.

3. The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight; encasement with the minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, or fittings, and to prevent damage to the polyethylene due to backfilling operations.

4. Overlaps and ends shall be secured with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place until backfilling operations are complete.

D. Pipe Installation

1. Immediately prior to placement in the trench, all pipe shall be inspected in the presence of the Engineer to verify that it is internally clean and free of damage. Damaged units shall be removed from the construction site and replaced to the satisfaction of the Engineer and at no additional cost to the Authority.

2. When lowering pipe into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

3. Lay pipe true to line and grade, with uniform bearing under the full length of its barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to line and grade shall be made by scraping away or adding material under the pipe.

4. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

5. Make up pipe joints in accordance with the manufacturer's instructions taking extreme care that joints are clean and free of foreign materials. Support pipe free of bedding during the joining process to avoid disturbing the subgrade. Pipe joints shall be sufficiently tight to meet testing specified herein.

6. In large diameter sewers with compression-type pipe joints, or where considerable force will be required to insert the spigot fully into the bell, come-alongs and winches or other equipment may be rigged to provide the necessary force. Inserts shall be used to prevent the sewer pipe from being thrust completely home prior to checking gasket location. After the gasket is checked, the inserts shall be removed and the joint complete.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement prior to backfilling ductile iron pipe.

3.03 FIELD TESTS

Unless otherwise shown on the Contract Drawings, test all installed pipe by infiltration/exfiltration test except that an air test will be required in lieu of the exfiltration test during the period that a Federal, State, or local "Water Drought Emergency" has been officially declared. Testing shall be performed in the presence of the Engineer.

A. Infiltration/Exfiltration Test

1. Equipment and procedures used in performing the infiltration/exfiltration test shall be in accordance with ASTM C 969 for Reinforced Concrete Pipe and ASTM F 2487 for Corrugated Polyethylene Pipe and subject to the approval of the Engineer.

2. Measure infiltration with a weir or other suitable measuring device.

3. The allowable infiltration rate including manholes shall be 200 gallons/inch of internal diameter/miles of pipe tested/24 hours, when the average groundwater head on the test section is 6 feet or less. When the average groundwater head on the test section is over 6 feet, the allowable infiltration rate shall be that given above multiplied by the ratio of the square root of the average groundwater head to the square root of the base head of 6 feet. If the infiltration rate exceeds the allowable limits given above, take the following remedial action:

   a. Take up and relay entire length of pipe, or

   b. At the Contractor's option, conduct additional tests to determine if excess infiltration can be attributed to a portion of the line. If it can, replacement may be confined to the faulty portion.

   c. Repeat tests until all pipelines prove satisfactory.

4. When an infiltration test is not practicable because of dry trench conditions, perform an exfiltration test. For exfiltration testing, the allowable leakage limit including manholes shall be 200 gallons/inch of internal diameter/miles of pipe tested/24 hours, when the average head on the test section is 3 feet or less. When the average head on the test section is greater than 3 feet, the allowable leakage shall be that given above multiplied by the ratio of the square root of the average test head to the square root of the base test head of 3 feet. Perform exfiltration tests, where directed by the Engineer, as follows:

   a. Fill sewer between successive manholes using a manhole standpipe system to provide test head.

   b. Determine leakage by measuring water required to maintain test head for required test period.

   c. If exfiltration leakage exceeds the rate specified above, proceed with the remedial action specified in 3.03 A.3.

5. Brace the test line in both lateral directions to prevent movement of pipe.

6. Submit one copy of all test result data to the Engineer on a daily basis.

B. Air Test

1. Equipment and procedures used in performing the air test for Reinforced Concrete Pipe shall be subject to the approval of the Engineer and in accordance with ASTM C924 for pipes up to 24 inches diameter and ASTM C1103 for pipes greater than 24 inches diameter.

2. Equipment and procedures used in performing the air test for Corrugated Polyethylene Pipe shall be subject to the approval of the Engineer and in accordance with ASTM F 1417 for pipes up to 36 inches diameter. Air testing is not recommended for Corrugated Polyethylene Pipe greater than 36 inches diameter.

3. The Contractor is directed to the safety precautions necessary when performing air tests as specified in ASTM C924, ASTM C1103 and ASTM F 1417.

4. Unless otherwise approved by the Engineer, the lines shall be tested from structure to structure.

5. Coat all capped and plugged fittings and all joints with soap solution to detect leakage.

6. Air control equipment shall be equipped with proper valves and pressure gages capable of controlling the air entry rate to the test section and monitoring the air pressure in the pipe line. The pressure relief valve shall be tested to ensure it is functioning properly.

7. Supply air to the test section slowly, filling the pipe until the minimum required test pressure, not to exceed 5 psig, is maintained. When groundwater elevation above the pipe indicates a test pressure in excess of 5 psig, discontinue air testing and conduct an infiltration test.

8. The minimum test time shall be as specified in ASTM C 924, ASTM C 1103 or ASTM F 1417. Where the test section includes laterals or pipes of different sizes, determine equivalent length by the ratio of the square of the diameter to the square of the diameter of the main line in accordance with Appendix X1 of ASTM C924.

9. If the pipe section or joint exceeds the allowable pressure loss specified by ASTM C924 ,ASTM C1103 or ASTM F 1417 respectively, the section or joint shall be considered to have failed the test. Repairs shall be made as specified in 3.03 A.3 above.

10. Submit one copy of all test result data to the Engineer on a daily basis.

3.04 PROTECTION

A. Care shall be taken not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing and other operations.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to retesting of joints, relaying pipe or replacing pipe. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

DIVISION 2

SECTION 02721

STORM DRAINAGE SYSTEM -

(INFILTRATION/EXFILTRATION TESTING REQUIRED)

SUBMITTALS

APPENDIX "A"

A. Submit catalog cuts of gaskets for pipe joints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the specified requirements and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified herein.

D. Submit certificate from the polyethylene film manufacturer that such polyethylene film complies with the requirements specified in this Section.

E. Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag, which shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with: Contract location, title and number; the name of the material supplied, and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

F. Submit plans, methods equipment and procedures as applicable for:

1. Prevention of accumulation of ground water as specified in 3.02.
2. Alternate method of line and grade control as specified in 3.02.
3. Infiltration/exfiltration and/or air testing as specified in 3.03.

G. Submit test results as specified in 3.03 on a daily basis.

H. Submit "As-Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02722

STORM DRAINAGE SYSTEM

(INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for exterior storm drainage systems not requiring infiltration/ exfilitration testing.

B. Definition of terms relating to Reinforced Concrete Pipe and Plastic Pipe shall be in accordance with ASTM C 822 and ASTM D 883 respectively.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 746	Ductile Iron Gravity Sewer Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Test Method for Material Finer Than .075mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 507	Reinforced Concrete Elliptical Culvert Storm Drain and Sewer Pipe
ASTM C 655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 822	Terminology Relating to Concrete Pipe and Related Products
ASTM D 883	Standard Terminology relating to Plastics
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications
ASTM D 3212	Standard Specification for Joints for Drain and sewer Plastic Pipes Using flexible Elastometric Seals
ASTM F 2306	12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity Flow Storm Sewer and Subsurface Drainage

application

American Water Works Association (AWWA)

AWWA C 104	Cement- Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with piping systems of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no additional cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe and appurtenances so as not to damage Authority or other public or private property, and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

Use any of the pipe sytems specified below unless otherwise shown on the Contract Drawings.

A. Reinforced Concrete Pipe

1. ASTM C 76, Class V, Wall B or Wall C for Circular Reinforced Concrete Pipe, ASTM C 507, Class HE-IV for Horizontal Elliptical Pipe and Class VE-VI for Vertical Elliptical Pipe, unless otherwise shown on the Contract Drawings. Use ASTM C 150, Type II Portland cement. Pipe joints shall be tongue and groove or bell and spigot, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. Pipe joints shall be sealed with rubber gaskets. Design of joints and physical requirements for rubber gaskets shall conform to ASTM C 443. Rubber gaskets shall be the following types of rubber gaskets, manufactured by Hamilton Kent Manufacturing Co., Toronto, Ontario or approved equal:

a. "Tylox Type C" for straight tongue and groove pipe

b. "Tylox Superseal " for offset pipe

c. "Tylox Type 0" for recessed pipe

B. Ductile Iron Pipe

1. ASTM A 746, minimum wall thickness Class 50 unless otherwise shown on the Contract Drawings, with push-on joints, and cement mortar lining, which shall be twice the standard thickness in AWWA C 104.

2. Joints shall be sealed with continuous ring rubber gaskets conforming to AWWA C 111.

3. Polyethylene Encasement for Ductile Iron Sewer Pipe: AWWA C 105, Class C polyethylene, 8-mil thickness.

C. Corrugated Polyethylene Pipe

1. ASTM F 2306, high density Polyethylene pipe, joints shall be bell and spigot and sealed with a continuous gasket.

2. Pipe joints shall be sealed with continuous ring rubber gaskets and conforming to ASTM F 477 and meet the requirements of ASTM D 3212.

C. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the storm drain is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Contract Drawings.

2. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet for nominal diameters up to 18 inches or outside diameter plus three feet for nominal diameters in excess of 18 inches, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. Or the Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load such as ASTM C 655 or ASTM A 746. A subtrench is defined as a trench excavated for pipe placement within a wider trench.

3. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer. Pipe shall be laid in a dry trench.

B. Pipe Support and Backfilling

1. Where concrete cradles are shown on the Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section entitled "CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.

2. Where crushed stone bedding is shown on the Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for the pipe bells, where applicable so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted layer, place and compact additional bedding material in small lifts to the dimensions shown.

3. a. Reinforced Concrete Pipe and Ductile Iron Pipe

Continue backfilling of the trench from the pipe support limits reached in 3.02 B.1 and 2 above in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING".

b. Corrugated Polyethylene Pipe

Place pipe embedment and backfilled in accordance with ASTM D 2321.

C. Polyethylene Encasement for Ductile Iron Pipe

1. Install polyethylene encasement on all ductile iron pipes using one of the installation methods described in AWWA C 105.

2. Pipe surface shall be totally cleaned prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or bedding material from becoming trapped between the pipe and the polyethylene encasement.

3. The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with the minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, or fittings, and to prevent damage to the polyethylene due to backfilling operations.

4. Overlaps and ends shall be secured with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place until backfilling operations are complete.

D. Pipe Installation

1. Immediately prior to placement in the trench, all pipe shall be inspected in the presence of the Engineer to verify that it is internally clean and free of damage. Damaged units shall be removed from the construction site and replaced to the satisfaction of the Engineer, at no additional cost to the Authority.

2. When lowering pipe into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

3. Lay pipe true to line and grade, with uniform bearing under the full length of its barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to line and grade shall be made by scraping away or adding bedding material under the pipe.

4. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

5. Make up pipe joints in accordance with the manufacturer's instructions and taking extreme care that joints are clean and free of foreign materials. Support pipe free of the bedding during the joining process to avoid disturbing the subgrade.

6. In large diameter sewers with compression-type pipe joints, or where considerable force will be required to insert the spigot fully into the bell, come-alongs and winches or other equipment may be rigged to provide the necessary force. Inserts shall be used to prevent the sewer pipe from being thrust completely home prior to checking gasket location. After the gasket is checked, the inserts shall be removed and the joint completed.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement prior to backfilling ductile iron pipe.

3.03 PROTECTION

A. Care shall be taken not to damage or displace installed pipes and joints during construction of pipe supports, backfilling and other operations.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to relaying pipe or replacing the pipe and/or testing of joints. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

DIVISION 2

SECTION 02722

STORM DRAINAGE SYSTEM -

(INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)

APPENDIX "A"

SUBMITTALS

A. Submit catalog cuts of gaskets for pipejoints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the specified requirements and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified in this Section.

D. Submit certificate from the polyethylene film manufacturer that such polyethylene film complies with the requirements specified in this Section.

E. Submit to the Manager, Materials, Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag which shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with: Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

F. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of accumulation of groundwater specified in 3.02.
2. Alternate method of line and grade control specified in 3.02.

G. Submit "As Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02765

CLEANING STORM DRAINAGE AND SANITARY SEWER SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the removal and disposal of debris and sediment from catch basins, manholes, sumps and scuppers, and from the connecting pipes of such catch basins, manholes and scuppers, to restore system capacity and/or in preparation for other Work.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

National Fire Protection Association (NFPA)

NFPA 329 "Recommended Practice for the Control of Flammable and Combustible Liquids and Gases"

1.03 PERFORMANCE REQUIREMENTS

A. Cleaning Requirements

1. Clean pipes and structures shown on the Contract Drawings or as directed by the Engineer.
2. Unless otherwise shown on the Contract Drawings, cleaning shall be for maintenance purposes, and shall remove all foreign matter, debris and sediment as required to restore each element of the system to a minimum of 95% of its original capacity.
3. Performance requirements for cleaning in preparation for other Work shall be as specified elsewhere or as shown on the Contract Drawings.

B. Site Condition Requirements

1. When Work in any area is completed, the Contractor shall clean the area, replace all covers and grates, and leave the area in a condition satisfactory to the Engineer.
2. The Contractor shall report to the Engineer any castings in need of replacement as specified elsewhere herein.

1.04 ENVIRONMENTAL REQUIREMENTS

A. The Contractor shall remove debris from the work sites and away from Authority property as it accumulates. Debris shall not be stored, burned, or otherwise disposed of on Authority property.

B. The Contractor shall handle and dispose of debris and sediments removed from the locations specified in 1.01 in accordance with the requirements of Appendix "A" of this Section and as shown on the Contract Drawings.

C. Unless otherwise specified on the Contract Drawings, water generated from cleaning operations under this Section shall be decanted back into the system from which it was removed.

1.05 SAFETY REQUIREMENTS

The warnings and recommendations of NFPA 329 shall be followed in order to ensure that the Work is performed safely.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Water required for the performance of the Work will be supplied to the Contractor at no cost to him and from a source within a reasonable distance from the work areas unless otherwise shown on the Contract Drawings. Water will not be made available from systems dedicated exclusively to fire protection.

2.02 CONSTRUCTION FEATURES

A. Pipe Cleaning Equipment:

1. Pigging: Hydraulically Propelled Equipment used shall be of a movable dam type, and shall be constructed in such a way that a portion of the dam may be collapsed at any time during cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned, and shall provide a flexible scraper around the outer periphery to ensure removal of grease. If sewer cleaning balls or other equipment that cannot be collapsed is used, special precautions to prevent flooding of the sewers and public and private property shall be taken.

2. High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles developing approximately 1000 psi of water pressure. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring walls and floors of structures. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall be a self-contained truck unit with its own water tank, auxiliary engines, pumps, and at least 200 feet of hydraulically driven hose on a reel.

3. Rodding: The Contractor shall provide all mechanically powered equipment necessary for proper rodding, bucketing, brushing, root cutting and flushing of the sewers in the sizes indicated in the Contract Documents. The equipment used for cleaning shall be that of a heavy-duty power rodding machine which is capable of rodding distances of up to 1,000 feet in one setup. It shall have the ability to spin the rod either clockwise or counterclockwise, be able to be pushed straight out or pulled back without rotating the machine. It shall also be capable of pulling pipe-size swabs or brushes back through the pipeline for cleaning and flushing purposes. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

4. Bucket Machine: The Contractor shall also provide heavy-duty bucket machines, as necessary, for use on dragline work to clean the pipeline with buckets, brushes, scrapers, swabs or other similar devices in order to effectively remove the debris and provide a clean sewer for the inspection.

5. Hydraulic Flusher: Hydraulic high-pressure sewer cleaners used for sanitary sewer cleaning shall be specifically designed and constructed for such cleaning. The sewer cleaner shall have a minimum usable water capacity of 600 gallons and a pump capable of delivering at least 30 gallons per minute (gpm) at 100 psi. Pressure to the nozzle shall be regulated by a relief valve adjustable from 1 to 1500 psi minimum.

B. Vacuum Truck

The vacuum truck shall have a minimum capacity of 13 cubic yards with a 25-foot minimum length vacuum hose. The vacuum truck shall be capable of removing debris such as dirt, sand, rocks, grease, and other solid, semi-solid and liquid material resulting from the cleaning operation.

C. Removal Equipment:

1. Vacuum truck as specified above.

2. Trash pumps.

3. Buckets, shovels and other equipment for manual removal of solids and semi-solids.

D. Testing Equipment

1. Approved atmospheric monitors that determine the presence of asphyxiating, toxic, and flammable or explosive atmospheric conditions in confined spaces.

2. Equipment shall be similar to monitors manufactured by GASTECH, Newark, CA.

PART 3. EXECUTION

3.01 PREPARATION

A. The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

B. Test each subsurface structure for combustible, toxic or otherwise harmful gases, vapors or airborne particulates prior to entry of personnel. Conform to recommendations of NFPA 329. If such gases, vapors or particulates are detected, ventilate and retest prior to entry.

C. The Contractor shall select and mobilize the cleaning, removal and testing equipment. Selection of the equipment used shall be based on the conditions of the system at the time the work commences. The equipment shall be capable of safely removing dirt, grease, rocks, sand, and other materials and obstructions from the pipes and structures. The Contractor shall obtain prior approval from the Engineer for all equipment and procedures to be employed in the performance of this Section.

3.02 APPLICATION

A. General

1. Remove debris and sediment from catch basins, manholes, pipes, tunnel sumps and scuppers to clear drainage paths and provide unobstructed water flow. Dispose of removed materials away from Authority property.

2. Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Sewers damaged, as a result of the Contractor's improper operations, shall be promptly repaired by the Contractor at no cost to the Authority.

3. All equipment, devices, and tools required for this Contract shall be owned (or leased) and operated by the Contractor.

B. Cleaning

1. Pipe cleaning shall be performed by using a high pressure water system or mechanically powered equipment designed for cleaning pipe systems. If successful cleaning of a pipe section cannot be performed, or if the equipment fails to traverse the pipe section, the Contractor shall set up at the other end or utilize other equipment and measures as directed by the Engineer and at no additional cost to the Authority. When, in the sole opinion of the Engineer, a major blockage exists which cannot be removed by methods specified in this Section, the cleaning effort will be abandoned.

2. Catch basins, manholes, sumps and scuppers shall be cleaned by use of a vacuum system, or by other means approved by the Engineer.

3. Debris accumulated during cleaning operations shall be removed from the sewer and properly disposed of in accordance with the approved Disposal Plan.

4. At no time will chemical solvents or treatments be used for the Work of this Section.

5. Cleaning shall be performed prior to lining of the sewer.

6. Cleaning Precautions

a. The Contractor shall take necessary precautions to prevent sewage backup and shall be responsible if damage results there from. Sewage diverted during cleaning operations shall be returned to the sanitary system and not discharged into any surface water body, storm drain system.

b. During all cleaning and preparation operations, all necessary precautions shall be taken to protect the sewer from damage. During these operations, precautions shall be also taken to insure that no damage is caused to public or private property adjacent to or served by the sewer or its branches. Any damage caused to public or private property as a result of such cleaning and preparation operations shall be restored to pre-existing conditions by the Contractor at no additional costs to the Authority.

c. Satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. Access to fire hydrants for the purpose of fire protection shall be maintained at all times.

C. Removal

1. Sludge, dirt, sand, rocks, grease, debris and other solid and semi-solid materials shall be removed at the downstream end of the section being cleaned.

2. These materials shall not be passed from section to section that could cause line stoppages, accumulations in wet wells, or damage to pumping equipment.

3. Root Removal

a. Roots shall be removed in the designated sewer sections and manholes where root intrusion is a problem and where authorized by the Engineer. Special attention should be used during the cleaning operation to ensure almost complete removal of roots from the joints.

b. Any roots which could prevent the proper seating and application of the liner shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupine, and equipment such as high-velocity jet cleaners.

c. Chemical root treatment shall be used before or following the root removal operation, depending on the manufacturer's recommendation. Contractor shall capture and remove all roots from the line at the downstream manhole.

(1) To aid in the removal of roots, pipeline sections that have root intrusion shall be treated with an acceptable herbicide. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. The active ingredients shall have no adverse effect

on the performance of the wastewater treatment plant, and shall be registered with the Environmental Protection Agency. Any damaged vegetation so designated by the Owner shall be replaced by the Contractor at no additional cost to the Authority. All safety precautions as recommended by the manufacturer shall be adhered to concerning handling and application of the herbicide.

D. Material Removal and Disposal

1. Unless otherwise specified in Appendix "A", the cleaning water from which solids have been separated shall be discharged back into the system from which it was removed.

2. All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. When hydraulic cleaning equipment is used a suitable dam or weir shall be placed in the downstream manhole to trap all such materials. Passing material from pipeline section to pipeline section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

3. Under no circumstances shall sludge or other debris removed during these operations be dumped or spilled into streets, ditches, storm drains or other sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the Contractor in accordance with the approved Disposal Plan at the Contractor's cost. Copies of records of all disposals shall be furnished to the Authority, indicating disposal site, date, amount and a brief description of material disposed. All materials shall be removed from the site no less often than the end of each workday and as specified in Appendix 'A'. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as acceptable by Engineer. The Contractor is advised that he shall not dispose of this material by legal or illegal dumping on private or public property, by sale to others, or any means other than those given above.

4. The Contractor shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accord with applicable law and regulations. The Contractor shall immediately clean up any such spill, or waste. If the Contractor fails to clean up such spill, or waste immediately, the Authority shall have the right to clean up or arrange for its cleanup and shall charge to the Contractor all costs, including administrative costs and overhead incurred by the Authority in connection with such cleanup. The Authority shall also charge to the Contractor any costs incurred or penalties imposed on the Authority as a result of any spill, dump or discard. Under no circumstances is this material to be discharged into the waterways or any place other than where authorized to do so by the appropriate authority.

5. The general requirements for vehicles hauling such waste material are as follows. Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles have watertight bodies, that they be properly equipped and fitted with seals and covers to prohibit material spillage or drainage, and that they be cleaned as often as is necessary to

prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic speed regulations.

6. The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

3.03 REMOVAL AND RESTORATION OF CASTINGS

A. At the time of removal of casting covers or grates, mark the edge of such cover or grate and edge of the frame in such a way so that the cover or grate can be restored in the same position relative to the frame. The lip of the frame shall be cleaned of debris so that the cover or grate fits securely in the frame.

B. The Contractor shall report to the Engineer any castings that are broken, or are worn such that the grate or cover is not continuously seated on the frame or is depressed more than 1/4" below the top of the frame.

3.04 FIELD TESTING

A. The basis for acceptance of the performance requirements shall be as specified herein unless otherwise shown on the Contract Drawings.

1. For pipes: Passage of the cleaning equipment in the presence of the Engineer. For hydrocleaning equipment, this shall include a return pass with the water jet "on" and showing no evidence of sediment being flushed back out of the pipe.

2. For catch basins, manholes, scuppers, sumps and open channels: Visual inspection of the clean bottom in the presence of the Engineer, or photographs.

B. The Contractor shall provide labor and equipment necessary to perform field testing at no additional cost to the Authority.

3.05 ACCEPTANCE OF CLEANING OPERATION

A. In Support of Rehabilitation Activities: Acceptance of sewer line cleaning shall be deemed sufficient when pipe is clean enough for installation of the particular rehabilitation method, in accordance with manufacturer's recommendations and the Engineer's approval.

B. Sewer Cleaning Only: Acceptance of sewer line cleaning shall be when a minimum amount of debris is observed to be removed from the sewer section.

END OF SECTION

SECTION 02765

CLEANING STORM DRAINAGE AND SANITARY SEWER SYSTEMS

APPENDIX "A"

Submittals shall be made by the Contractor as describe below:

A. Submit plans, methods, equipment and procedures as applicable for cleaning pipes and structures as specified in 3.01 C.

B. The Contractor shall submit a Disposal Plan for preview and acceptance by the Engineer prior to performing any work that might generate waste materials. The plan shall include a complete description of the materials that are expected to be encountered and their proposed disposal site(s). The Contractor may change his Disposal Plan only by written notice to the Authority. The acceptance of a plan and/or any related notice to the Authority must be evidenced by a written response from the Engineer.

C. The Contractor shall insure that all permits related to his disposal operations have been obtained, and the Contractor shall comply with all requirements of those permits. The Contractor shall show evidence that all required permits have been obtained for all disposal sites by submitting a copy of all such permits to the Authority as part of the Contractor's Disposal Plan.

D. The Contractor shall submit copies of records of all disposals of solids or semisolids resulting from cleaning operations.

E. The Contractor shall submit clarification in writing that backup equipment is available and can be delivered to the site within 24 hours.

END OF APPENDIX "A"

DIVISION 2

SECTION 02831

PVC-COATED STEEL CHAIN LINK FENCE AND GATES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for polyvinyl chloride (PVC)-coated steel chain link fence including the following:

1. Furnishing and installing new fencing;
2. Removal of existing fencing;
3. Relocation of existing fencing.

B. Definitions of terms related to chain link fencing shall be in accordance with ASTM F 552.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 318	Building Code Requirements for Structural Concrete.
	American Society for Testing and Materials (ASTM)
ASTM A 121	Specification for Metallic-Coated Carbon Steel Barbed Wire.
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 824	Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence.
ASTM B 117	Practice for Operating Salt Spray (Fog) Apparatus.
ASTM B 429	Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
ASTM F 552	Standard Terminology Relating to Chain Link Fencing.
ASTM F 567	Practice for Installation of Chain-Link Fence.
ASTM F 626	Specification for Fence Fittings.
ASTM F 668	Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
ASTM F 900	Specification for Industrial and Commercial Swing Gates.
ASTM F 934	Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
ASTM F 1043	Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
ASTM F 1083	Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
ASTM F 1184	Specification for Industrial and Commercial Horizontal Slide Gates.

UL 325 Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.03 QUALITY ASSURANCE

Upon request arrange for the Engineer to inspect all fencing materials at the place of manufacture.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Arrange for fence fabric and accessories to be delivered to the construction site in packed cartons or firmly tied rolls.

B. Verify that each package is identified and bears the manufacturer's name.

C. Store fence fabric and accessories in a secure and dry area.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Sliding gates shall be one of the following with no substitutions permitted:

"Secure-Trac" by
Merchants Metals
Houston, Texas 77060

"Easy Track" by
Boundary Fence and Railing Systems, Inc.
Richmond Hill, NY 11418

"Fortress Gate" by
Tymetal Corporation
Clifton Park, NY 12065

2.02 MATERIALS

A. General

1. Chain link fence components shall be PVC-coated over the metallic coating specified herein except that PVC coating shall be omitted from the barbs of barbed wire and where it would interfere with operation of the gates.
2. Take field measurements prior to preparation of Shop Drawings and fabrication.

3. Unless otherwise specified herein, fence posts, rails, fittings, gates and other accessories shall be PVC-coated in the same color as the fabric.

4. Unless otherwise specified herein or shown on the Contract Drawings, the materials, coatings and shapes shall be of uniform type and manufacture.

B. Fence Fabric

1. PVC-coated steel chain link fence fabric shall conform to the requirements of ASTM F 668.

2. Unless otherwise shown on the Contract Drawings, fabric shall conform to the following:

   a. Two-inch mesh.

   b. Zinc or aluminum coated steel core wire of 6 (0.192" O.D.) gage exclusive of PVC coating.

   c. Class 2b (thermally fused) PVC coating meeting the thickness requirements of ASTM F 668.

3. Color shall be as shown on the Contract Drawings.

4. Fence fabric height shall be as shown on the Contract Drawings. For fabric height of six feet and over, top and bottom selvage shall be twisted and barbed, unless otherwise shown on the Contract Drawings. For fabric height of less than six feet, both top and bottom selvages shall be knuckled.

C. Barbed Wire

1. Each line of barbed wire shall consist of two strands of No. 12 1/2 gauge (0.099-inch diameter) wires twisted with 4 point No. 14-gauge barbs spaced approximately 5 inches apart.

2. Extension arms shall be 45 degrees, extended outward as shown on the Contract Drawings and slotted to support three lines (unless otherwise shown on the Contract Drawings) of barbed wire such that the outermost line is positioned approximately 12 inches horizontally from the fence line.

3. End and intermediate vertical members of gates shall be extended vertically 12 inches and shall be provided with the necessary clips to secure barbed wire.

D. Fence Framing

1. PVC-coated steel posts and rails shall conform to ASTM F 1043 for Heavy Industrial Fence.

2. External and internal coatings shall conform to ASTM F 1043 for the fence framework material group furnished. PVC coating shall be 10 mils minimum, thermally fused. Framework shall demonstrate the ability to withstand salt spray when tested in accordance with ASTM B 117, based on certified test results, as follows:

   a. Exterior: 1000 hours with maximum 5% red rust.

   b. Interior: 650 hours with maximum 5% red rust.

3. Steel sections shall be as shown on the Contract Drawings. Unless otherwise shown, equivalent steel sections may be substituted for the sections shown on the Contract Drawings. Equivalent sections shall conform to ASTM F 1043 Group IC - Round Steel Pipe, Group II - Roll Formed Steel Shapes or Group III - Hot-rolled Shapes and shall have bending strengths at least equal to those of the sections shown on the Contract Drawings as determined by ASTM F 1043.

4. Zinc-coated, round, steel pipe shall conform to the applicable portions of ASTM F 1083, Standard Weight Pipe (Schedule 40) with a minimum yield strength of 30,000 psi.

5. PVC-coated rail sleeves and connectors shall allow for expansion and contraction of the rail. Use sleeves of the same material as the rail having a minimum length of 6 inches, or provide rails swedged at one end for a minimum length of three inches for connecting into a continuous run. Furnish and install suitable fittings for securing rails to terminal posts.

E. Gates

1. General

a. Gate types, opening widths and directions of operation shall be as shown on the Contract Drawings.

b. Gates shall conform to the requirements specified for PVC-coated steel chain link fence except that PVC-coated aluminum alloy framing conforming to ASTM B 429 may be used.

c. Gates shall be designed and constructed for operation by one person.

d. Where shown on the Contract Drawings, gates shall be topped with three lines of barbed wire, meeting the requirements of 2.02 C.1.

2. Swing Gates

a. Swing gates shall be factory assembled and shall swing 180 degrees.

b. Gates shall conform to ASTM F 900 except that framing shall be assembled by welding at the corners. Use of corner fittings will not be permitted.

3. Sliding Gates

a. Sliding gates shall be factory assembled by one of the manufacturers specified in this Section.

b. For overhead and cantilever sliding gates, the materials, manufacture and dimensions and weights of frame members and posts shall, at a minimum, meet the requirements of ASTM F 1184, Class 2 (internal rollers).

c. Rollers for overhead and cantilever sliding gates shall be equipped with ball bearings. Non-sealed ball bearings shall be provided with a grease fitting for periodic maintenance. Rollers shall be secured to post or frame without welding.

4. Cantilever Sliding Gates

a. Gate Frame: Made in accordance with ASTM F 1184 Type II Class 2, and in compliance with UL-325. Gate to be made of Aluminum Alloy 6005-T6. All square members are 2" sq. weighing 0.94 lb/FT (139 kg/m). Complete frame welded to top (HI-STRENGTH) one piece track and top frame member and 4" x 2" bottom rail weighing 1.71 lbs./ft.. Supply 2 truck assemblies that are swivel type having lubricated and scaled ball bearing wheels that will align in the track during all normal operations of the gate.

Standard Opening	Standard Support Overhang
10'0"	6'6"
11'0" through 14'0"	7'6"
15'0" through 22'0"	10'0"
23'0" through 30'0"	12'0"
31'0" through 40'0"	16'0"

b. Gates 31'0" to 40'0" dual top tracks welded together to form a single top member weighing 9.32 lb/ft..The bottom rail 4" x 2" weighing 1.71 lb/ft.. Top tracks require two additional truck assemblies.

Gate Finish (Frame)	Polymer Coated in color to match fence
Chain Link Fabric Filler	Thermally Fused & Bonded PVC

Chain link fabric filler installed using hook bolts that are inserted through pre-drilled holes in the frame. To these hook bolts the fabric will be attached by means of a tension bar which is laced through the last link of the fabric. The hook bolts are 15" on center and all four sides of the gate.

Diagonal adjustable 1/4" stainless steel truss cables provided inside each panel of the gate. (One each direction).

Truck assembly: Swivel type, zinc die cast, with 4 sealed lubricant ball bearing wheels 2" in diameter. The load bearing wheels have an extruded dynamic load rating of 4,500 pounds each. And 2 side rolling wheels to ensure truck alignment in track. Truck assemblies are held to post brackets using 5/8" diameter stainless steel bolts which have a load rating of 11,000 pounds. Truck assembly to withstand 2,000 lb reaction load.

c. Bottom guide wheel assemblies: Each assembly shall consist of two 3" diameter wheels with covers Per UL-325 and ASTM F 2200, straddling bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. Attach one assembly to each guide post.

F. Tension Wire

1. Conform to ASTM A 824, Type I or Type II.

G. Accessories and Fittings

1. Furnish all necessary fittings for installation of fence as a complete unit including, but not limited to, post and line caps, rail and brace ends, rail sleeves, tie wires and clips, tension and brace bands, tension bars, truss rods and barbed wire extension arms.
2. Fence fittings shall be PVC coated and shall conform to ASTM F 626.
3. Unless otherwise specified herein, all ferrous accessories and fittings shall be zinc-coated at a minimum of 1.25 oz./sf in accordance with ASTM A 153.
4. Furnish malleable iron non-lift-off type hinges offset to permit 180-degree swing gate opening.

5. Furnish malleable iron forked type latch with padlock eye suitable for operation from both sides of gate.
6. Furnish two-inch cylinder type padlock for each gate and provide 3 keys for each padlock.
7. Furnish gate stops for double gates consisting of a mushroom type flush plate with anchors capable of being set in concrete and designed to engage center drop rod or plunger.
8. Furnish keepers to hold the gate leaf in the fully open position until manually released.
9. Wire ties shall be of the same material and coating as the fabric.

H. Concrete

Concrete for post footings shall attain a minimum compressive strength of 3000 psi in 28 days and shall conform to the requirements of ACI 318 for mixing and placing.

PART 3. EXECUTION

3.01 PREPARATION

Prepare the grade and remove surface irregularities, if any, which may cause interference with the installation of chain link fence.

3.02 REMOVAL OF EXISTING FENCING

A. Where shown on the Contract Drawings, remove existing fence including fabric, gates, posts and other appurtenances. Unless otherwise shown on the Contract Drawings, cut post footings 3 feet below the existing ground surface and grout resulting voids.

B. Unless otherwise shown on the Contract Drawings, fencing materials and debris resulting from removal operations shall be disposed of away from Authority property.

3.03 INSTALLATION

A. Comply with applicable provisions of ASTM F 567.

B. Install fence with all posts vertical and all components to the line and grade shown on the Contract Drawings.

C. Connect to existing fence at an existing terminal post or by installation of an end post. Subject to approval by the Engineer, an existing line post may be converted to a terminal post by installation of appropriate brace rails and brace rods.

D. The clear opening from end posts to buildings, fences and other structures shall not exceed two inches.

E. Excavate holes for posts to the diameter and spacing shown on the Contract Drawings without disturbing the underlying materials. Holes resulting from removal of existing post footings may be reused as approved by the Engineer.

F. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Confirm vertical and top alignment of posts and make necessary corrections. Extend concrete footings one inch above grade and trowel to a crown to shed water. Unless otherwise approved by the Engineer, no materials shall be installed on the posts nor shall any post be disturbed within seven days after the individual post footing is completed.

G. For non-FAA contracts only, use of mechanical devices may be substituted for concrete in the setting of line posts, provided the Contractor can demonstrate to the satisfaction of the Engineer that such mechanical devices will develop a strength in the ground equal to or greater than that of concrete footings shown on the Contract Drawings.

H. Stretch chain link fabric taut and securely fasten to posts. Cut fabric, and independently attach each span to terminal posts with tension bars and tension bands spaced a maximum of 15 inches apart. Fasten fabric to line posts with tie wires, bands or other method approved by the Engineer, spaced a maximum of 15 inches apart. Fasten top edge of fabric to top rail or top tension wire at intervals not exceeding 24 inches. Fasten bottom edge of fabric to bottom tension wire with wire ties at intervals not exceeding 24 inches. Join rolls of wire fabric by weaving a single strand into the end of the rolls to form a continuous mesh. Install the bottom of the fence fabric to within two inches of the finished ground or pavement surface. Grade where necessary to provide a neat appearance.

I. Install fabric on security side of fence.

J. Firmly seat barbed wire extension arms or caps on tops of posts.

K. Stretch barbed wire tightly to remove all sag; firmly install it in slots of extension arms and anchor it to the terminal extension arms.

L. Install fabric on gate frames with stretcher bars at vertical edges. Install fabric at top and bottom edges with stretcher hooks at not more than 15-inch intervals.

M. Install gates plumb, level and secure for full opening without interference. For double gates, install ground-set, mushroom type, flush plate in concrete. Adjust hardware for smooth operation and lubricate where necessary.

N. Install horizontal brace rails with diagonal truss rods and turn-buckles at all terminal posts.

3.04 RELOCATION OF EXISTING FENCING

A. Remove existing fabric where shown on the Contract Drawings for installation on new posts. Prevent damage to the fabric. Repair or replace any damaged fabric to the satisfaction of the Engineer at no additional cost to the Authority.

B. Remove and dispose of existing posts and accessories as specified in 3.02

C. Furnish and install new posts, footings and accessories as specified in this Section.

D. Install the removed fabric as specified in 3.03.

3.05 ELECTRICAL GROUNDS

At each location where an electric transmission, distribution or power line passes over the fence, construct electrical ground conforming to the following requirements:

A. Construct electrical grounds per Section 16450 "Grounding"

B. Ground the fence directly beneath the point where a power line passes over the fence and additionally approximately every 20 feet for 250 feet on each side of the power line crossing and at corner posts.

C. Ground fences at both sides of gates or at other opening in the fence with flexible braided ground strap.

D. Bond across all gates and openings with a buried bonding jumper.

E. The ground shall be accomplished with a copper clad rod 10 feet (3000 cm) long and 3/4 inch (20 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. Use a 4/0 AWG bare stranded copper conductor for the ground grid and 1/0 AWG for connection to fence posts. For above ground connections use a double-bolt compression type connector and for below grade use exothermic welded connections.

F. The grounding loop shall have less than 5 ohms resistance to ground.

G. Make all connections to fence posts or other PVC-coated conductive material to bare metal, clean from PVC materials.

H. Bond each barbed wire strand to a grounded fence post or grounding conductor.

I. Ground the fence wire mesh fabric, unless it is held in place by conductive tie-wraps or similar device.

J. Construct electrical grounds at other locations along the fence as shown on the Contract Drawings.

END OF SECTION

SECTION 02831

PVC-COATED STEEL CHAIN LINK FENCE AND GATES

APPENDIX "A"

SUBMITTALS

A. Submit shop drawings of chain link fence and gates in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS.

B. Submit manufacturer's certificates of compliance with all requirements for material types, coatings, etc. specified in this Section including, but not limited to, fabric, barbed wire, fence and gate framing, tension wire, fittings and accessories. Submit certification that rail and roller track assembly for sliding gates are designed for the specified reaction load.

C. Submit representative samples of fabric to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397.

D. Submit certified test results for:

1. Salt spray testing of framework.
2. Concrete compressive strength.

E. Submit methods, types of equipment and other information required by the Engineer to demonstrate equivalent strength of mechanical line post setting devices.

END OF APPENDIX "A"

DIVISION 2

SECTION 02837

STEEL FENCE AND GATES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies materials and construction requirements for the removal and storage of existing steel fence and gates and furnishing and installing of new Steel Fence and Gates, at the locations shown on the Contract Drawings.

B. Items specified in this Section include but are not limited to the following, where shown on the Contract Drawings:

1. Access Fence and Gates at Arch Abutments.
2. Arch Chord gates.

C. Related Construction Specified in Other Sections

1. See Division 3 Section 03602 on grouting for non-shrink, non-metallic grout.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 318	Building Code Requirements for Reinforced Concrete
	American Society of Civil Engineers (ASCE)
ASCE 7	Minimum Design Loads for Buildings and Other Structures
	American Society of Mechanical Engineers (ASME)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Locks, and Plain Washers (Inch Series)
ASME B18.8.1	Clevis Pins and Cotter Pins
ASME B18.8.2	Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series)
	American Society for Testing and Materials (ASTM)
ASTM A36	Specification for Carbon Structural Steel
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153	Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM E1512	Standard Test Methods for Testing Bond Performance of Bonded Anchors
ASTM F436	Specification for Hardened Steel Washers
ASTM F1145	Standard Specification for Turnbuckles, Swaged, Welded, Forged
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.

1.03 STRUCTURAL PERFORMANCE

A. Unless otherwise shown on the Contract Drawings, provide fence and gate assemblies capable of withstanding structural loads required by ASCE 7, without exceeding allowable design working stresses of materials for fences, gates, anchors and connections. Submit structural calculations, signed and sealed by a Professional Engineer, licensed in the state where the fence and gates are to be installed, to the Engineer for approval.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 QUALITY ASSURANCE

A. Manufacturer: Fence and gates shall be manufactured by a firm with a minimum of 5 years experience in the production of steel fence and gates. Manufacturers proposed for use shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Verify that the entity performing installation work of this Section is a firm that is approved by the fence and gate manufacturer and shall have worked on at least 3 projects involving complexities equal to those required for the work of this Section.

C. Upon request arrange for the Engineer to inspect fencing materials at the place of manufacture.

D. Fence panels shall be delivered to the construction site in preassembled sections.

E. Single-Source Responsibility: Obtain fence and gates, including accessories, fittings, and fastenings, from a single source.

F. Field Measurements: Verify layout information for fence and gates shown on the Contract Drawings by field measurements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Fence and gate materials and accessories shall be delivered to the construction site in packed cartons or palletized and securely bundled.

B. Each package shall be identified and shall bear the manufacturer's name.

C. Store fence materials and accessories in a secure and dry area.

1.06 SUBMITTALS

For submittal requirements see Appendix "A" to this Section.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Take field measurements prior to preparation of shop drawings and fabrication.
2. Unless otherwise specified herein or shown on the Contract Drawings, the materials, coatings, and shapes shall be of uniform type and be the products of a single manufacturer.

B. Fence and Gates

1. The steel fence and gates shall be manufactured from structural carbon steel as per ASTM A 36.
2. Fasteners and Fittings:

   a. For Access Fence and Gates at Arch Abutments, provide standard bolts, regular hexagon head conforming to ASTM A307 with plain hexagon nuts and plain washers conforming to ASME B18.2.2 and ASME B18.21.1 respectively.

   b. For Arch Chord Gates, provide high strength bolts, regular hexagon head conforming to ASTM A325 with high strength nuts and flat washers conforming to ASTM A563 and ASTM F436 respectively.

   c. Anchor Bolts shall conform to ASTM A307.

   d. Hinge Pin for Arch Chord Gates shall conform to ASME B18.8.2.

   e. Cotter Pin for Arch Chord Gates shall conform to ASME B18.8.1.

   f. Turnbuckles for Access Gates at Arch Abutments shall conform to ASTM F1145 with minimum working load limit of 1,000 lbs. Tension rod shall conform to ASTM A36.

   All fasteners and fittings shall be galvanized according to ASTM A153

3. Expanded Metal Mesh shall be manufactured by Mcnichols or approved equal. Opening size shall be as shown on the Contract Drawings.
4. Swinging Gate Lock shall be model 8030 manufactured by RR Brink Locking Systems Inc. or approved equal.
5. Torsion Spring for Arch Chord Gates shall be model no. 760865 manufactured by Stanley or approved equal.
6. Heavy Duty Hinge for Access Gates at Arch Abutments shall have minimum capacity of 220 lbs/each.

C. Coating

1. All steel fence and gate assemblies shall be hot-dip galvanized in accordance with ASTM A123. Repair damaged galvanized surfaces with galvanizing repair method and paint conforming to ASTM A780.

2.02 FABRICATION IN GENERAL

A. Metalwork must be well formed to shape and size, with lines, angles, and curves true. Provide necessary rabbets, lugs, and brackets so that the work can be assembled. Conceal fasteners where practical.

Design metal items to withstand expansion and contraction of the component parts at an ambient temperature of 100 degrees F without causing harmful buckling, opening of joints, overstressing of fasteners, or other harmful effects.

Welded fabrication must meet requirements as specified in AWS D1.1. Execute all welds behind finished surfaces without distortion or discoloration of the exposed side. Welded joints must be cleaned of flux and dressed on exposed and contact surfaces.

Drill or punch holes for fasteners. Drilling and punching must produce clean true lines and surfaces.

Mill all joints to a close fit. Corner joints must be coped or mitered, well formed, and in true alignment. Joints exposed to weather must be formed and fabricated to exclude water.

B. Fabricate steel fence and gates as indicated on the Contract Drawings with additional fabrication tolerances as follows:

1. Plumbness: When the fence/gate assemblies are erected in upright position, the out-of-plumb dimensions in both in-plane and out-of-plane directions measured between the top end and the bottom end of the fence/gate assemblies shall not exceed 0.250 inch.
2. Flatness: The fence/gate assemblies shall be free of any warp, bow, or twist. When the fence/gate assemblies are laid onto a flat horizontal surface, any gaps between the fence/gate assemblies frame and the surface shall not exceed 0.250 inch.
3. Straightness: For any straight members of the fence/gate assemblies, the permissible variation for straightness shall be 0.125 inch times length of the member (in feet) divided by 5.

PART 3. EXECUTION

3.01 PREPARATION

A. Verify locations of existing steel fence and gates to be removed and salvaged for reuse as follows:

1. Verify and flag limits of existing steel fence for removal and obtain approval by the Engineer, prior to removal operations.
2. Upon the approval of the Engineer, remove, transport and store existing fence panels at a location to be determined by the Authority.

3.02 SITE INSPECTION

A. Verify areas to receive fencing are completed to final grades and elevations.

3.03 INSTALLATION

A. Install fence and gates with all posts vertical and all components to the line and grade shown on the Contract Drawings.

B. Welds

1. All fence construction to be welded as per the Details shown on the Contract Drawings.
2. E70 Low Hydrogen Electrodes shall be used for welds unless otherwise approved by the Engineer in writing.
3. All welds shall be ground smooth.

C. Fence panel shall be welded or bolted to posts as shown on the Contract Drawings.

D. Pickets shall be welded to rails as shown on the Contract Drawings.

3.04 PROTECTION

A. Protect Work of this Section from damage during shipping, handling, and erection.

B. Replace damaged fence or gates.

3.05 WARRANTY

A. Provide manufacturer's standard limited warranty covering steel fence and gates system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of fifteen (15) years from date of installation. Warranty shall run to Authority's benefit and shall grant the Authority direct right of action against manufacturer.

END OF SECTION

SECTION 02837

STEEL FENCE AND GATES

APPENDIX "A"

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

1. Product data, installation instructions and recommendations for all fence and gate materials. Include data substantiating that materials comply with requirements of this Section.
2. Shop Drawings, include plans, elevations and detail sections clearly delineating the locations of each type of fence and gate unit. Include materials, gauge, methods, types of joinery, fasteners, and accessory items. Shop drawings to be signed and sealed by a professional Engineer, licensed in the state where the fence and gates are to be installed.
3. If different type of fence and gate not shown in the Contract Drawings are selected, provide design calculations for fence and gate components of the selected type, signed and sealed by a professional Engineer, licensed in the state where the fence and gates are to be installed.
4. Representative samples of galvanized finish for steel fance and gates.

B. Submit to the Engineer

1. Qualification data for manufacturer, as required by 1.04 of this Section to demonstrate its capabilities and experience. Include list of completed projects with project names, addresses, names of architect and owners, plus other information specified.
2. Evidence of fence and gate manufacturer's approval of installer.

C. Submit manufacturer's certificates of compliance with all requirements for materials specified in this Section.

D. Where the fences are not manufactured by the gate manufacturer, submit the gate manufacturer's written recommendation for the fences which are to be furnished.

END OF APPENDIX "A"

DIVISION 2

SECTION 02841

W-BEAM AND THRIE-BEAM GUIDE RAIL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for W-beam and Thrie-beam guide rail.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 30	Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
AASHTO M 102	Steel Forgings, Carbon and Alloy, for General Industrial Use
AASHTO M 133	Preservatives and Pressure Treatment Process for Timber
AASHTO M 180	Corrugated Sheet Steel Beams for Highway Guardrail

American Society for Testing and Materials (ASTM)

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 563	Carbon and Alloy Steel Nuts

1.03 QUALITY ASSURANCE

A. Guide rails and appurtenances may, at the option of the Engineer, be inspected at the place of manufacture.

B. Furnish certificate for each type material specified in 2.01, certifying that such material complies with the applicable specified requirements.

C. Guide rails and appurtenances will be visually inspected when delivered to the construction site. Any such material that does not meet requirements of this Section or is damaged, shall be removed from the construction site and replaced with satisfactory material.

D. All stages of installation will be inspected by the Engineer for compliance with the provisions hereof and conformance to required line and grade. Any failures to comply shall be immediately corrected to the satisfaction of the Engineer.

1.04 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel Guide Rail and Terminal Sections

AASHTO M 180, CLASS B, TYPE 2, for W-Beam or Thrie-Beam, as shown on the Contract Drawings.

B. Posts, Spacers, Plates, Rub Rail and Anchorage Units

ASTM A 36 of type and size shown on the Contract Drawings, galvanized in accordance with ASTM A 123. No punching, drilling, cutting or welding will be permitted after galvanizing. When shown on the Contract Drawings, provide rub rail.

C. Bolts and Nuts

Conform to AASHTO M 180.

D. Miscellaneous Hardware for End Treatments

When end treatments are shown on the Contract Drawings, conform to AASHTO M 180 except as follows:

1. Guide rail end treatment cables shall conform to AASHTO M 30, Type 1 with Class A coating. Swaged fittings shall be fabricated from forged steel conforming to AASHTO M 102.
2. Nuts for guide rail end treatment shall conform to ASTM A 563, Grade A.
3. Plates and rods for guide rail end treatment shall be structural steel conforming to ASTM A 36 and galvanized in accordance with ASTM A 123.

E. Timber Posts for Breakaway Cable Terminals

Where shown on the Contract Drawings, provide timber posts having a stress grade of 1200 pounds per square inch or more as tested in accordance with requirements of West Coast Lumber Inspection Bureau, Southern Pine Inspection Bureau or other appropriate Timber Association. Posts may be rough sawn or dressed and shall be treated with a preservative conforming to AASHTO M 133 with retention property of six pounds of creosote per cubic foot of timber, minimum.

PART 3. EXECUTION

3.01 INSTALLATION

A. Posts shall be set to the required depth. Posts shall be plumb, properly spaced and to the prescribed line and grade as shown on the Contract Drawings.

B. Prior to driving the posts or excavating for concrete footings, the exact location of underground utilities that may conflict with the posts shall be determined. Post spacing may be adjusted by six inches or double spacers may be used, as approved by the Engineer, to eliminate such conflicts.

C. Damage to utilities due to the performance of the Work shall be located and repaired at no additional cost to the Authority.

D. The rail elements shall be erected with the top edge in a straight line or smooth curve, parallel or concentric to the roadway. Where a vertical transition is required, the top edge of rail elements shall form the chords of a smooth vertical curve. No punching, drilling, reaming, cutting or welding of the rail elements will be permitted in the field.

E. Where earth is of a type that cannot be drilled using a mechanical earth auger, obtain approval from the Engineer for an alternate method of installing posts.

F. If concrete Footings are required, support posts at proper line and grade as shown on the Contract Drawings in such a manner so that they will not be displaced during concreting operations.

G. Use erectors trained by manufacturer.

H. Touch up all damage to the zinc coating with an approved type paint.

I. Paint portions of posts to be imbedded in concrete with two heavy coats of an approved bitumastic paint.

3.02 STAGING FOR INSTALLATION ADJACENT TO EXISTING ROADWAYS

Install W-beam and Thrie-beam guide rail in the following sequence:

A. Approach terminal end shall be the first section installed.

B. Posts and rails shall be constructed in the direction of traffic.

C. At the end of a work period, all posts that have been installed shall have the rail elements attached.

D. New guide rail shall be installed prior to the removal of an existing system, if any, unless otherwise shown on the Contract Drawings.

END OF SECTION

SECTION 02841

W-BEAM AND THRIE-BEAM GUIDE RAIL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02841A01 Submit Detailed shop drawings of all components of the guide rail installation in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 2

SECTION 02843

PERMANENT CONCRETE BARRIERS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for permanent concrete barriers as specified herein and as indicated on the Contract Drawings. Permanent barriers may include, but not be limited to, concrete safety shape barriers (referred to as NJ-shape or Jersey barriers); Single Slope concrete barriers, F shaped concrete barriers, concrete barrier transition to vertical face, and concrete barrier transition to concrete curb.

1.02 REFERENCES

American Society for Testing and Materials (ASTM International)

ASTM A36	Carbon Structural Steel
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	Carbon Steel Bolts and Studs, 60,000-psi Tensile Strength Externally Threaded Standard Fasteners
ASTM C150	Portland Cement

Compliance with the following as applicable

FHWA	Federal Highway Administration
MUTCD	Manual on Uniform Traffic Control Devices
NYSDOT	New York State Department of Transportation Standard Specifications
NJDOT	New Jersey Department of Transportation Standard Specifications

1.03 COORDINATION

A. Coordination installation of anchorages.

B. Furnish setting drawings, templates, and directions for installing anchorages including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete or masonry.

C. Deliver items to the project site in time for installation

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of one of the following, or approved equal:

2.02 MATERIALS

A. General

1. Provide new barriers and materials or, if acceptable to the Engineer, undamaged previously used barriers and materials in serviceable condition conforming to the requirements specified in this Section, and as shown on the Contract Drawings.

2. Type F shaped concrete barriers shall be NCHRP 350 (TL-5) Crash tested products.

3. After delivery, a construction site inspection of the barriers and equipment will be made by the Engineer. If any barriers and equipment has been damaged or if, for any reason, the equipment does not comply with the requirements herein, repair or replace the barriers and equipment at its own cost and expense, even though the barriers and equipment had been inspected for shipment. After such satisfactory replacement and/or repair and subsequent Engineer written approval, the barriers shall be installed.

B. Concrete Safety Shape Barriers

1. Type 'F' concrete barrier safety shape, NYSDOT Single Slope Concrete Barrier and NJDOT 'Jersey' safety shape, and concrete barrier transitions.

C. Precast Concrete Barriers

1. Barriers shall be manufactured with white Portland cement concrete in accordance with the Contract Drawings, which depict New York and New Jersey requirements. If the Contract Drawings are superseded by later New York or New Jersey Standards, then the most recent Standards shall be used, and the Contractor shall furnish Shop Drawing(s) as specified herein highlighting the change(s).

2. Concrete shall be proportioned to produce 4,500-psi reinforced concrete.

3. Connectors, Anchors and Accessories: Fabricated ASTM A36 shapes, plates and bars welded into assemblies required, with ASTM A307 steel bolts, and other fasteners as required. Finish each assembly and fastener with ASTM A123 hot-dip zinc coating.

For New York Contracts

See NYSDOT Standard Specifications Section 704-05.

For New Jersey Contracts

See NJDOT Standard Specifications for Road and Bridge Construction Section 607.

D. Barrier Reflectors:

1. If specified on the Contract Drawings, barrier reflectors shall be 6-inches by 6-inches, high intensity reflectorized, spaced at 20-feet on center with a minimum mounting height of 30-inches to the bottom of the reflectors. The reflector shall be white or yellow, matching the pavement edge line, or as shown on the Contract Drawings.

E. Barrier Lights:

1. If specified on the Contract Drawings barrier lights shall be steady burn Type C, spaced at 20-feet on center with a minimum mounting height of 30-inches to the bottom of the lens or as specified on the Contract Drawings. Type B flashing lights shall be placed on the approach end of barrier at 10-feet on center or as shown on the Contract Drawings.

F. Chain Link Fence:

1. If specified in the Contract Drawings, chain link fence shall be placed on the permanent concrete barrier as shown on the Contract Drawings.

G. Glare/Gawk Shield

1. Install glare/gawk shield as specified by the manufacturer or as shown on the Contract Drawings

PART 3. EXECUTION

3.01 PREPARATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Protect the installation and maintenance by providing and placing permanent traffic control devices as indicated on the Contract Drawings.

3.02 INSTALLATION

A. Install barriers at locations shown on the Contract Drawings and as outlined in manufacturer's installation instructions.

B. Provide Styrofoam pad shimming and leveling as required to ensure smooth and continuously aligned barriers.

C. If not specified on the Contract Drawings, taper ends of barriers shall be flared away from traffic at a rate of 18 to 1 or flatter. Terminate blunt approach end with an impact attenuator as approved by the Engineer as specified herein or as specified on the Contract Drawings.

D. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface or as shown on the Contract Drawings.

E. Install reflectors and lights as specified herein, and as shown on the Contract Drawings.

3.03 MAINTENANCE

A. Maintain, clean, relocate, and replace barriers, reflectors and lights as required to protect motorists, pedestrians, and workers throughout the Work of this Contract.

3.04 FIELD QUALITY CONTROL

A. Additional testing and inspection shall be performed to determine compliance with Federal, State, and local requirements.

END OF SECTION

SECTION 02843

PERMANENT CONCRETE BARRIERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents including plans, elevations, sections, details, attachments to other work. Indicate dimensions, required clearances, method of field assembly, and location and size of each field connection.

B. Product Data for each type of product indicated.

C. Certification from the concrete barrier supplier stating that the concrete barrier(s) meet the requirements of the Contract Drawings.

D. Proposed equipment procedures to be used for installing and maintaining the barrier(s).

E. Proposed end treatment details and catalog cuts.

END OF APPENDIX "A"

DIVISION 2

SECTION 02844

TEMPORARY CONCRETE BARRIER

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for temporary concrete barriers.

B. Coordinate the Work of this Section with the requirements of "MAINTENANCE OF TRAFFIC AND WORK AREA PROTECTION" of DIVISION 1 - GENERAL PROVISIONS.

C. Materials and constructions of this Section constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Contract Drawings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM C 150	Portland Cement

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES AND MATERIALS

A. General

Provide new barriers and materials or, if acceptable to the Engineer, undamaged previously used barriers and materials in serviceable condition conforming to the requirements specified in this Section, and as shown on the Contract Drawings.

After delivery, a construction site inspection of the barriers and equipment will be made by the Engineer. If any barriers and equipment has been damaged or if, for any reason, the equipment does not comply with the requirements herein, the Contractor shall repair or replace the barriers and equipment at its own cost and expense, even though the barriers and equipment had been inspected for shipment. After such satisfactory replacement and/or repair and subsequent Engineer written approval, the barriers shall be installed.

B. Precast Concrete Barriers

1. Shall be manufactured with white portland cement concrete in accordance with the Contract Drawings which depict New York and New Jersey requirements. If the Contract Drawings are superseded by later New York or New Jersey Standards, then the most recent Standards shall be used, and the Contractor shall furnish Shop Drawing(s) in accordance with paragraph 1.03 B highlighting the change(s).

2. Concrete shall be proportioned to produce 3000 psi reinforced concrete.

3. Barrier sections less than 10 feet shall have one drainage pocket, and sections greater than 10 feet shall have two drainage pockets conforming to the size shown on the Contract Drawings, or styrofoam pads shall be provided to allow adequate drainage, as shown on the Contract Drawings.

4. Connectors, Anchors and Accessories:- Fabricated ASTM A 36 shapes, plates and bars welded into assemblies required, with ASTM A 307 steel bolts, and other fasteners as required. Finish each assembly and fastener with ASTM A 123 hot-dip zinc coating.

C. Barrier Reflectors

If specified on the Contract Drawings, barrier reflectors shall be 6" x 6", high intensity reflectorized, spaced at 20 feet on center with a minimum mounting height of 30 inches to the bottom of the reflectors. The reflector shall be white or yellow, matching the pavement edgeline; or as shown on the Contract Drawings.

D. Barrier Lights

If specified on the Contract Drawings barrier lights shall be steady burn Type C, spaced at 20 feet on center with a minimum mounting height of 30 inches to the bottom of the lens or as specified on the Contract Drawings. Type B flashing lights shall be placed on the approach end of barrier at 10 feet on center or as shown on the Contract Drawings.

E. Chain Link Fence

If specified in the Contract Drawings, chain link fence shall be placed on top of the temporary concrete barrier as shown on the Contract Drawings.

F. Glare/Gawk Shield

Install glare / gawk shield as specified by the manufacturer or as shown on the Contract Drawings.

PART 3. EXECUTION

3.01 PREPARATION

Protect the installation, maintenance, relocation and removal by providing and placing temporary traffic control devices in accordance with the requirements of the specification titled "Maintenance of Traffic and Work Area Protection" in Division 1.

3.02 INSTALLATION

A. Install barriers at locations shown on the Contract Drawings.

B. Provide styrofoam pad shimming and leveling as required to ensure smooth and continuously aligned barriers.

C. Taper ends of barriers shall be flared away from traffic at a rate of 10 to 1 or flatter. Terminate blunt approach end with an impact attenuator as approved by the Engineer in accordance with paragraph 1.03 D or as specified on the Contract Drawings.

D. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface or as shown on the Contract Drawings.

E. Install reflectors and lights as specified herein, and as shown on the Contract Drawings.

3.03 MAINTENANCE

A. Maintain, clean, relocate and replace barriers, reflectors and lights as required to protect motorists, pedestrians, and workers throughout the Work of this Contract.

3.04 REMOVAL

A. Remove barriers away from Authority property, when the need has ended, when replaced by approved use of permanent construction, or when directed by the Engineer.

B. Restore damaged permanent construction, and replace construction that cannot be satisfactorily repaired, all at no cost to the Authority.

END OF SECTION

SECTION 02844

TEMPORARY CONCRETE BARRIERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02844A01 Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents.

Catalog Cuts

02844B01 Proposed equipment Catalog Cuts and procedures to be used for installing, maintaining, relocating and removing the barrier(s).

Certificates

02844E01 Certification from the concrete barrier supplier stating that the concrete barrier(s) meet the requirements of the Contract Drawings.

Construction and Installation Procedures

02844G01 Proposed end treatment details and Catalog Cuts including but not limited to impact attenuator type.

END OF APPENDIX "A"

DIVISION 2

SECTION 02848

GUIDERAIL AND BARRIER DELINEATORS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for guiderail and concrete barrier curb mounted delineators. The delineators shall consist of a trapezoidal shaped plastic body with a flat plastic retro reflective lens to reflect light at wide angles from a single direction. The lens shall be hermetically sealed to the plastic body.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The delineator color, location and spacing shall be as shown on the contract drawings.

B. Delineators shall be mounted on guiderail or concrete barrier curb as shown on the Contract Drawings.

1.03 QUALITY ASSURANCE

A. Inspection

1. After the installation of delineators, an inspection by the Engineer shall be made in the day time for proper location, line and grade alignment and visibility. They shall also be inspected at night for improper orientation, specular reflection and other defects more conspicuous at night. All apparent defects disclosed after the day and night inspections shall be corrected by the Contractor to the satisfaction of the Engineer at no additional cost.

B. Optical Requirements

1. Definitions:

Entrance Angle shall mean the angle between the illumination axis and the retro reflector axis at the retro-reflector.

Observation Angle shall mean the angle between the illumination axis and the observation axis at the retro-reflector.

Coefficient of Luminous Intensity (R|) shall mean the ratio of the luminous intensity of the retro-reflector in the direction of observation to the illuminance at the retro-reflector on a plan perpendicular to the direction of the incident light. For center mount reflectors, R| is expressed in candelas per incident lux (cd/lx). The equivalent English term is specific intensity expressed in candles per foot candle (cd/ft-c).

2. Coefficient of Luminous Intensity (Specific Intensity)

The Coefficient of Luminous Intensity (R|) of each reflex retro-reflector intended for use as a delineator shall be equal to or exceed the minimum values shown in Table 1. Measurements shall be made with the delineator mounted with its long axis vertical. Failure to meet the minimum (R|) shall constitute failure of the delineator being tested; failure of more than 2 reflectors out of 50 subjected to test shall constitute failure of the lot.

TABLE 1

OBSERVATION ANGLE degrees	ENTRANCE ANGLE degrees	COEFFICIENT OF LUMINOUS INTENSITY cd/lx		SPECIFIC INTENSITY cd/ft-c
		Crystal	Yellow	CrystalYellow
0.1	0	11.0	6.6	11971
0.1	+15	11.0	6.6	11971
0.1	+35	4.6	2.8	5030

3. Optical Testing Procedure

4. A random lot of retro-reflectors shall be tested. Coefficient of luminous intensity shall be measured at 30.5 m (100 feet) test distance, spacing between source center and receptor center shall be 5.33 cm (2.1 in.), receptor diameter and source diameter shall each be 2.54 cm (1.0 in.). Other test distances 15.2 m (50 feet) and above may be used provided that the angular aperture requirements are met. (See ASTM E809, Measuring Photometric Characteristics of Retro-reflectors). During testing the delineator shall be oriented in the photometric device with its long axis vertical and mounted to simulate either mounting on the vertical side of a concrete barrier or in a guiderail.

5. Determination of acceptability shall be based on MIL-STD-105D using Special Inspection Level S-3 and an AQL of 1.5.

C. Seal Test:

The following test shall be used to determine if a reflector is adequately sealed against dust and water.

Submerge 50 samples in water bath at room temperature. Subject the submerged samples into a vacuum of five (5) inches gage for five (5) minutes. Restore atmospheric pressure and leave samples submerged for five minutes, then examine the samples for water intake. Failure of more than 2% of the number tested shall be cause for rejection.

D. Heat Resistance Test:

Three delineators shall be tested for one hour in a circulating air oven at 52°C plus or minus 3°C (125°F). The test specimens shall be placed in a horizontal position on a grid or perforated shelf permitting free air circulation. At the conclusion of the test the samples shall be removed from the oven and permitted to cool in air to room temperature. The samples after exposure to heat shall show no significant change in shape and general appearance. The assembly shall meet all optical and physical requirements. No failures will be permitted.

E. Sampling Procedure

For qualification purposes only, 50 samples required for all of the tests set forth in this specification may be submitted by the manufacturer. For acceptance purposes, the 50 samples will be selected at random by the purchaser from each shipment. Sample lot and acceptance practice shall be the same regardless of the size of the shipment unless specified otherwise.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Reflectors

1. Body

Dimensions 6.7 cm x 14.5 cm x 5.9 cm.

(2.6 in. x 5.7 in. x 2.3 in.)

Angle of Reflecting Face: 11°

Surface: The surface shall be smooth except for identification

Material: The body shall be molded of polymethyl methacrylate meeting requirements ASTM D788 Grade 8.

2. Lens

The lens shall consist of a smooth front surface free from projections or indentations other than identifications markings. The rear surface of the lens shall have a prismatic configuration such that it will affect total internal reflection of light. The manufacturer's trade mark shall be molded legibly into the face of the lens.

Reflective Area (Projected): 48.4 sq. cm. (7.5 sq. in.)

Material: The lens shall be molded of polymethyl methacrylate meeting requirements ASTM D788 Grade 8.

Surface: The surface shall be smooth except for identification.

B. Mounting

An adhesive approved by the manufacturer is applied to the base of the delineator body for bonding to the concrete barrier and to the sides of the body for bonding into a guiderail.

2.02 FABRICATION

A. Delineators shall be fabricated as shown on the Contract Drawings.

B. All of the delineator units must be fabricated from the same material.

PART 3. EXECUTION

3.01 LAYOUT

A. Delineators shall be laid out as shown on Contract Drawings.

3.02 INSTALLATION

A. The delineator reflective units shall be positioned to be clearly visible for a distance of 1000 feet during the hours of darkness under normal weather and atmospheric conditions when illuminated by the upper beams of standard automobile headlights when the vehicle is located in the adjacent traffic lane approaching the delineator.

3.03 PROTECTION

A. When delineators are installed on the guiderail, care shall be taken so as not to damage the appearance or structural features of the guiderail. All damaged features shall be repaired or replaced, at no additional cost, to the satisfaction of the Engineer.

3.04 ADJUSTMENTS

A. The Contractor shall be responsible for removing to the satisfaction of the Engineer, delineators installed in unauthorized areas.

END OF SECTION

SECTION 02848

GUIDERAIL AND BARRIER DELINEATORS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Submit catalog cuts for reflector units and materials in 2.01 of this Section.

B. Submit manufacturer's installation instructions for guiderail and barrier delineators.

END OF APPENDIX "A"

DIVISION 2

SECTION 02850

PLYWOOD SIGN PANELS AND WOOD SIGN POSTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following:

A. Plywood sign panels for use in the construction of temporary (TYPE 1) and permanent (TYPE 2) guide, warning and regulatory roadway signs. Sign type usage, TYPE 1 or TYPE 2, shall be identified on the Contract Drawings for each required sign.

B. Wood sign posts and footings for both TYPE 1 and TYPE 2 sign panel side-of-road installations.

1.02 REFERENCES

The following is a listing of organizations and publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals (LTS-2).

Manual for Signing and Pavement Markings of the National System for Interstate and Defense Highways (MUTCD)

AASHTO M 168	Wood Products

American Society for Testing and Materials (ASTM)

ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM B 209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 211	Aluminum-Alloy Bar, Rod and Wire
ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM D 245	Methods for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A 325	Quenched and Tampered-Steel Bolts and Studs with suitable Nuts and Plain Washers
ASTM D 2555	Methods for Establishing Clear Wood Strength Values

American Wood Preservers Association (AWPA)

AWPA C 1	Timber Products - Preservative Treatment by Pressure Processes
AWPA C 14	Wood for Highway Construction, Pressure Treatment

Douglas Fir Plywood Association

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highway (MUTCD)

Standard Alphabets for Highway Signs

Standard Lower-case Alphabets for Highways

United States Department of Commerce (USDC)

Product Standard PS-1 Soft Plywood, Construction and Industrial

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design of signs and sign structure shall provide sufficient strength to withstand a wind loading of 80 miles per hour as per AASHTO LTS-2.

B. Sign supports and framing shall be designed to meet the required wind loading. Posts shall be designed for direct embedment in the soil by excavation and back fill, or by driving with hand or mechanical equipment.

1.04 QUALITY ASSURANCE

Each plywood sheet shall be grade marked and certified in accordance with the standards adopted by the Douglas Fir Plywood Association.

1.05 DELIVERY, STORAGE AND HANDLING

All sign components and materials shall be transported and handled in a manner that shall cause no permanent deformation, injury or damage. Sign components and materials to be stored shall be stored above ground.

1.06 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Plywood Sign Panels

1. Plywood sign panels shall conform to the requirements set forth in USDC Product Standard PS-1 for Douglas Fir Plywood.

2. The plywood panels for TYPE 1 signs shall be exterior-type plywood, 5-ply and A-C grade or better.

3. The plywood panels for TYPE 2 signs shall be high-density overlay, exterior marine-type plywood, 5 ply and B-B grade or better. Inner plies for TYPE 2 panels shall be B grade veneers or better.

4. The thickness of plywood sign panels and plywood battens shall be not less than 1/2 inch for TYPE 1 panels and not less than 3/4 inch for TYPE 2 signs.

5. The overlay surface for TYPE 2 plywood sign panels shall consist of a cellulose-fibre or sheet, in which not less than 40 percent by weight of the laminate shall be a thermo-setting resin of the phenol or melamine type. The resin-impregnated material shall be not less than 0.009 inches thick and shall weigh at least 60 lbs per 1000 square feet of single face, including both resin and fiber. The resin impregnation shall be sufficient to attach the surfacing material to the plywood. The bond shall be equal in performance to the glue lines between the sheets of veneer that make up the plywood.

6. The face of the cellulose-fibre overlay surface for TYPE 2 panels shall be hard, smooth, and of such quality that further finishing by paint or varnish is not required to fabricate the sign as specified in 2.03 of this Section.

B. Panel Sheeting and Screen Printing

1. Reflectorized Sheeting

   Shall be Scotchlite Brand Engineer Grade Series 2200 (heat activated adhesive) or Series 3200 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., 223-3N 3M Center, St. Paul, Minnesota 55144, or approved equal.

2. Non-Reflectorized Sheeting

   Shall be Scotchcal Brand film Series 650 (heat activated adhesive) or Series 3600 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., or approved equal.

3. Screen Printing Inks, Thinners and Toners

   a. Scotchlite Brand Process Colors Series 700 for use on Reflectorized Sheeting.

   b. Scotchcal Brand Process Colors Series 3900 and 4100 for use on Non-Reflectorized Sheeting.

   c. Approved equals for use on approved reflective and non-reflective sheetings.

4. Panel sheeting (reflective or non-reflective) and screen printing usage shall be shown on the Contract Drawing.

C. Wood Sign Posts

1. Wood sign posts shall be dry, No. 1 grade, S4S, Douglas Fir, Southern or Ponderosa Pine, Hemlock, Spruce or Western Larch conforming to the applicable requirements of AASHTO M 168. The posts shall be straight and true, free of splits, knots and warps or, of steel or aluminum components.

2. All the posts shall be pressure-treated with CCA in accordance with the applicable requirements of AWPA C1 and AWPA C 14.

3. Posts shall be surfaced four sides, have a uniform cross-section, and shall be sized not less than 4 inches by 4 inches. The post shall be graded for the following stress grades in accordance with the grading rules developed from ASTM D 245 for the selected stress grades. Using the clean wood properties of ASTM D 2555, the bending stress of the post in a TYPE 1 panel installation shall be not less than 1200 psi, and not less than 4000 psi for a TYPE 2 panel installation.

D. Stiffeners, Brackets and Miscellaneous Hardware

1. Horizontal and vertical sign panel stiffeners (Z bars) and panel brackets shall be fabricated of aluminum alloy 6061-T6 conforming to ASTM B 221.

2. Other miscellaneous aluminum hardware including bolts, nuts, washers, screws, rivets, pull-type lockbolts and serrated or knob stem blind rivets shall be fabricated to meet the requirements of ASTM B 209 and ASTM B 211 for Alloy 2024-T4. Component designated as Alloy 2024-T4 shall be given a chromated sealed anodic coating.

3. High strength steel bolts, nuts and washers shall conform to ASTM A 325. High-strength bolts, nuts and washers shall be galvanized in accordance with ASTM A 153.

E. Footings

1. Soil bearing plates shall be attached at the bottom of the post as required in 1.03 of this Section, or as shown on the Contract Drawings.

2. Breakaway post, if required, shall be as shown on the Contract Drawings. Breakaway post and footings shall be designed in accordance with the requirements of 1.03 of this Section.

3. Concrete footings, if required by 1.03 of this Section, shall be Class "B" concrete conforming to the Section entitled "Concrete."

4. Portable sign supports shall be as described in "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

2.02 CONSTRUCTION FEATURES

A. Sign face text, symbol, and border layouts shall be in accordance with "Maintenance of Traffic and Work Area Protection", of Division 1 - GENERAL PROVISIONS, or the Contract Drawings conforming to the requirements of:

1. The AASHTO Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways.

2. The FHWA MUTCD.

3. The FHWA Standard Alphabets for Highway Signs.

4. The FHWA Standard Lower-case Alphabets for Highways.

B. Sign characters shall be as shown on the Contract Drawings and shall include letters, numerals, symbols and borders.

C. Sign corner and border radii shall be approximately one-eighth of the height of the sign but shall not exceed 12 inches. Sign borders shall be of the same type character as the legend and shall be approximately the same width as the stroke width of the major lettering or the sign.

2.03 FABRICATION

A. Holes shall be drilled; cut edges shall be smooth and true, and free from burrs or ragged breaks. All fabrication except for cutting the lower ends of embedded posts shall be done in the shop. The plywood panels shall be clean, dry, and free from oils, dust, grit, or any other contaminants that would adversely affect the adhesion of the Reflectorized and Non-Reflectorized sheeting.

B. In preparing TYPE 1 panels for Reflectorized and Non-Reflectorized Sheeting, the entire Grade A surface to be covered shall be wiped down with a tack cloth to remove all saw dust and sanding residue.

C. In preparing TYPE 2 panels for Reflectorized and Non-Reflectorized Sheeting, the entire portion of the overlay surface to be covered, shall first be given a light, firm abrasion with steel wool (medium to fine grade) saturated with xydol, V.M.&P. Naphtha or similar commercial solvent. The surface shall then be wiped clean and dry. An alternate method of panel pre-treatment that consists of a solvent wipe, immediately followed by vapor degreasing (tri-chloroethylene) for a minimum period of 6 minutes may be used.

D. All panel and batten surfaces to be glued shall be slightly roughened and then glued with waterproof adhesive prior to assembly.

E. After panel preparation, the edges and back or rear surface of all TYPE 2 panels and battens shall be painted with two coats of approved white exterior paint.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall erect and remove signs as shown on the Contract Drawings, or as ordered by the Engineer, and in such a manner that the traveling public is informed and protected at all times.

B. Side-of-road ground mounted signs shall normally be erected so that the sign face is truly vertical to the profile line and the intersection angle measured between the sign face and the centerline of the travel lane, which the sign serves shall be 93 degrees. Where lanes divide or on curves, sign faces shall be oriented so as to be most effective both day and night, and to avoid the possibility of specular reflection.

C. The wood sign posts for side-of-road mounting shall be embedded in the soil to the depth required by the design specified in 1.03 of this Section. The hole for the embedment shall be excavated using a manual post-hole digger or appropriate size power driven auger. After the hole has been excavated, the post shall be aligned to the sign face direction, held vertical in the hole and suitable excavated material shall be tamped in the annular space. Holes resulting from sign post removals shall be filled by the Contractor to restore the area to its original state as directed by the Engineer.

D. All signs shall be securely fastened to their supports with bolts, nuts and washers of aluminum (2024-T4 alloy) or hot-dip galvanized steel conforming to 2.01 D of this Section, as required by the design specified in 1.03 of this Section.

E. Plywood battens and aluminum panel stiffeners shall be utilized as required by 1.03 of this Section and shall conforming to the applicable requirement of 2.01 of this Section.

F. Horizontal and vertical sign clearances shall be as shown on the Contract Drawings.

G. Other non-wood post mounting of plywood signs, such as overhead sign installations shall be as shown in the Contract Drawings.

H. Concrete footings, if required by 1.03 of this Section, shall be placed in accordance with the requirements of the Section of these Specifications entitled "Concrete," and shall not extend more than 4 inches above grade.

3.02 FIELD INSPECTION

A. Immediately prior to erection, all material shall be inspected by the Engineer for damage.

B. The Engineer will inspect each completely erected sign for proper location, line and grade of signs, vertical post alignment, condition, appearance, reflectorization and visibility.

C. As the Work progresses, the location, position and condition of all signs shall be monitored by the Contractor in accordance with "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

END OF SECTION

SECTION 02850

PLYWOOD SIGN PANELS AND WOOD SIGN POSTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

02850A01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS: Detailed sign face layout for all TYPE 2 sign panels showing letter height, width, brush stroke, spacing between letters, words, symbols and lines, border width, symbols details, and overall dimensions of the sign panels. Detailed sign face layouts are not required for TYPE 1 sign panels.

02850A02 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:
Shop drawings of sign panel and posts showing the sizes of the members and their connection details. The shop drawings shall also show the total length of the posts for each sign and give an elevation view of each of the completely erected signs with vertical clearance below the lowest sign panel to adjacent roadway, and other relevant dimensions.

Catalog Cuts

02850B01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS: Catalog cuts of all the materials to be used for sign faces.

Calculations

02850H01 Prior to fabrication, submit computations for the design of the sign panels and supports, as required in 1.03 of this Section, signed by a Professional Engineer licensed to practice in the State where the Work is to be performed.

END OF APPENDIX "A"

DIVISION 2

SECTION 02851

ALUMINUM SIGN PANELS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the work consisting of fabricating, installing and covering aluminum sign panels for the use in the construction of directional, guide, warning and regulatory roadway signs.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Association of State Highway Transportation Officials (AASHTO)

Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (LTS-2)

American Society for Testing and Materials (ASTM)

ASTM A153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High Temperature Service
ASTM A325	High Strength Bolts for Structural Steel Joints
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B211	Aluminum-Alloy Bar, Rod, Wire and Extruded Shapes
ASTM B221	Aluminum-Alloy Extruded Bars and Shapes

Compliance with the following, as applicable

AWS D 1.2	Structural Welding Code - Aluminum
FHWA	Federal Highway Administration
MUTCD	Manual on Uniform Traffic Control Devices

- Standard Alphabets for Highway Signs
- Standard Lower-case Alphabets for Highways
- Standard Traffic Signs

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design of signs, supports and framing shall provide sufficient strength to withstand a wind loading of 80 miles per hour as per AASHTO LTS-2.

B. All wind loadings shall be adjusted for height, drag, and gusting in accordance with AASHTO LTS-2

1.04 DELIVERY, STORAGE AND HANDLING

A. All sign components and materials shall be transported and handled in a manner that shall cause no permanent deformation, injury or damage. Sign components and materials to be stored above ground.

1.05 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Aluminum Sign Panels

1. Aluminum sheets and plates shall conform to ASTM B209, Alloy 6061-T6.
2. Fabricate panels from standard sheet widths with a thickness as follows:

   Ground mounted signs without Z-bars shall be 10 gauge thick, Ground mounted signs with Z-bars less than or equal to 30 square feet shall be 10 gauge thick, Sign panels for ground mounted ground mounted sign panels greater than 30 square feet shall be 8 gauge thick, Sign panels for overhead mounted sign panels shall be 8 gauge thick.
3. The panel blanks shall be free from laminations, blisters, open seams, pits, holes or defects that may affect their strength, appearance or use. The thickness shall be uniform and the blanks shall be commercially flat.

B. Panel Sheeting and Screen Printing

1. Reflectorized Sheeting

   3M Diamond Grade DG3 Reflective sheeting or approved equal. All reflective guide sign sheeting shall be ASTM D4956 Type XI
2. Non Reflective Sheeting

   Scothlite Brand film Series 650 (heat activative adhesive) or series 3600 (pressure sensitive adhesive) as menufactured by the Traffic Control Materials Division of the 3M Co. or approved equal.
3. Screen Printing Inks, Thinners and Toners

A. 3M Diamond Grade DG3 Reflective sheeting series 4000 or approved equal.

B. Scotchcal Brand Process Colors Series 3900 and 4100 for use on Non Reflective Sheeting or approved equal.

4. Panel sheeting (reflective or non-reflective) and screen printing usage shall be as shown on the Contract Drawings.

C. Stiffeners, Brackets and Miscellaneous Hardware

1. Horizontal and vertical sign stiffeners (Z bars) and panel brackets shall be fabricated of aluminum alloy 6061-T6 conforming to ASTM B221.

2. Other miscellaneous aluminum hardware including bolts, nuts, washers, screws, rivets, pull type lock bolts and serrated or knob stem blind rivets shall be fabricated to meet the requirements of ASTM B209 and B211 for Alloy 2024-T4. Component designated as Alloy 2024-T4 shall be given a chromate sealed anodic coating.

3. High strength steel bolts, nuts and washers shall conform to ASTM A325. High strength bolts, nuts and washers shall be galvanized in accordance with ASTM A153.

4. Stainless steel nuts shall conform to ASTM A194, Grade 8F, except that the nuts shall be lock nuts with semi-finished hex nuts equivalent to American Standard Heavy Series. Stainless steel bolts, washers and screws shall conform to ASTM A193 austenitic steel.

2.02 CONSTRUCTION FEATURES

A. Sign face text, symbol, and border layouts shall be in accordance with the Contract Drawings and conform to the following requirements of:

1. The FHWA Manual on Uniform Traffic Control Devices (MUTCD).

2. The FHWA Standard Alphabets for Highway Signs.

3. The FHWA Standard Lower case Alphabets for Highway Signs.

B. Sign characters shall be as shown on the Contract Drawings.

C. Sign corner and border radii shall be approximately one-eighth (1/8) of the height of the sign but shall not exceed 12 inches, or as shown in the FHWA Standard Traffic Sign. Sign borders shall be of the same type character as the legend and shall be approximately the same width as the stroke width of the major lettering of the sign or as shown in the FHWA Standard Traffic Sign.

2.03 FABRICATION

A. All shearing, cutting and punching shall be performed prior to preparing the blanks for application of reflective material. All edges and corners shall be filed or ground smooth leaving the entire sign blank free from sharp edges.

B. The blanks shall be cleaned, degreased and chromated or otherwise properly prepared in accordance with the sheeting manufactures recommendations. After treatment, a device method or clean cotton gloves shall be used in handling the sign blank until the reflective sheeting is applied. All fabrication except for cutting the lower ends of embedded posts shall be done in the shop. The aluminum panels shall be clean, dry, and free from oils, dust, grit or any other contaminants that would adversely affect the adhesion of the Reflectorized and Non-Reflectorized sheeting.

C. Welding of aluminum shall consist of inert gas shielded metal arc welding with combustible electrodes. All welding of aluminum shall be performed in the shop. No field welding of aluminum shall be permitted. All welders shall be qualified in accordance with the qualification procedures of AWS D 1.2.

D. Necessary drilling of holes required for shop and field assembly after sheeting is applied shall be done such that the drill bit does not snag, rip, or damage the sheeting outside of the drill hole. Holes shall be deburred prior to assembly.

E. Exposed bolt heads on the face of the assembly sign shall be touched up with enamel paint of the same color as the sheeting surrounding the bolts.

PART 3. EXECUTION

3.01 INSTALLATION

A. Erect and remove signs as shown on the Contract Drawings.

B. Side of the road ground mounted signs shall be erected so that the sign face is truly vertical to the profile line and the intersection angle measured between the sign face and the centerline of the travel lane which the sign serves shall be 93 degrees. Where lanes divide or curve, sign faces shall be oriented so as to be most effective both day and night, and to avoid the possibility of specular reflection.

C. All sign panels shall be securely fastened to their supports with bolts, nuts and washers of aluminum (2024-T4 alloy), hot dip galvanized steel or stainless steel conforming to 2.01D and 1.03 of this Section.

D. Horizontal and vertical sign clearances shall be as shown on the Contract Drawings.

E. Signs shall be covered to eliminate noncurrent, conflicting or unneeded information. The cover shall be held in place and positioned so that none of the sign face shows. More than one layer of fabric may be required to prevent legibility of the sign legend to be covered. The cover shall remain in place until the sign is no longer in conflict with current conditions.

3.02 FIELD INSPECTION

A. Immediately prior to erection, all material will be inspected by the Engineer for damage that is attributed to improper transportation, handling or storage procedures.

B. An inspection of each completely erected sign shall be made in the daylight for proper location, line and grade of signs, vertical post alignment, condition, appearance and visibility.

C. As the Work progressed, the location, position and condition of all signs shall be monitored by the Contractor in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS

D. Ground mounted Sign locations shown on the Contract Drawings are approximate, the exact location for each sign will be approved by the Engineer in the field.

E. Any deviation from the above indicated procedures shall be approved by the Engineer.

END OF SECTION

SECTION 02851

ALUMINUM SIGN PANELS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop drawings of sign panels showing the sizes of the members and their connection details including joining and anchorage, stiffening and bracing.

B. Catalog cuts of all the material to be used for sign panel faces.

C. Prior to fabrication, submit computations for the design of the sign panels and supports as required in 1.03 of this Section, signed by a Professional Engineer licensed to practice in the State where the Work is to be performed.

END OF APPENDIX "A"

DIVISION 2

SECTION 02854

IMPACT ATTENUATORS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the work consisting of furnishing and installing impact attenuators, and installing foundations for impact attenuators in accordance with the contract documents, the working drawings, and as directed by the Engineer.

1.02 REFERENCES

American Society for Testing and Materials (ASTM International)

ASTM A36	Metal Parts
ASTM A123	Zinc (Hot Dipped Galvanized) Coating on Iron and Steel Products
ASTM A153	Zinc Coating (Hot Dipped) on Iron and Steel Hardware
ASTM A193	Anchor studs
	Compliance with the following as applicable
FHWA	Federal Highway Administration
MUTCD	Manual on Uniform Traffic Control Devices
NYSDOT	New York State Department of Transportation Standard Specifications

1.03 QUALITY ASSURANCE

A. Impact attenuators and appurtenances may, at the option of the engineer to be inspected at the place of manufacture.

B. Furnish Certificate for each type material specified in Part 2, certify that such material complies with the applicable specified requirements.

C. Impact attenuators and appurtenances shall be visually inspected when delivered to the construction site. Any such material that does not meet requirements of this Section or is damaged shall be removed from the construction site and replaced with satisfactory material.

D. All stages of installation will be inspected by the Engineer for compliance with the provisions hereof and conformance to required line

1.04 STORAGE

A. If intermediate storage is required, the Contractor shall store and protect impact attenuators. Damaged parts shall be replaced with like parts in satisfactory condition or be repaired to the satisfaction of the engineer.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of one of the following, or approved equal:

2.02 MATERIALS

A. Impact Attenuators shall be NCHRP 350 crash tested products.

1. All Metal Work - ASTM A36

2. Anchors and Bolts - ASTM A193, Grade B7 Anchor Studs. All Bolts shall be American Standard regular bolts.

3. Nose cover shall be of high density polyurethane material

4. Fender Panels shall be fabricated from 10 gage steel.

5. Anchor Plates, transitions and diaphragms - ASTM A36

6. Modules - Type A and Type B.

7. Monorail Assembly - Shall be fabricated to the dimensions shown on the manufactures or working drawings

8. Reflectorized Sheeting Class B, Class C or Class E (High Intensity) Sheeting.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall install Reusable Impact Attenuators on existing or new foundations in accordance with the contract documents and the working drawings

B. Manufacturer's drawings, modified as necessary to reflect site conditions, will be referred to as "working drawings." Working drawings prepared by the Contractor will take precedence over manufacturer's drawings. Working drawings shall show attenuator system: supports, transition pieces, connections, miscellaneous parts, concrete or steel back-up structure, and anchorages not detailed in the plans, but which are necessary to develop the full performance of the impact attenuator. Attenuator mounting surface or foundation slab details and limits will be shown in the working drawings. Any component not supplied by the manufacturer will be labeled as "PROVIDED BY OTHERS". A minimum of 7 calendar days prior to beginning work, the Contractor shall submit three (3) copies of working drawings to the Engineer. The submission shall include the manufacturer's certification that modifications made to manufacturer's drawings reflecting site conditions will not impair the satisfactory performance of the impact attenuator as designed and tested under NCHRP requirements. All aspects of the working drawings shall be implemented in the field, including any alterations of the concrete barrier or other obstruction being shielded.

C. When the concrete pavement is not sufficient to meet the anchorage requirements the Contractor shall construct a reinforced concrete foundation slab and back-up structure to the dimensions indicated in the working drawings. The foundation slab shall be not less than the thickness indicated on the working drawings, or 8 inches, whichever is greatest. The concrete shall be batched in accordance with Section 03301 *Portland Cement Concrete*. If accelerators are needed, the Contractor shall submit the concrete mix design to the Materials Bureau for prior approval. The concrete shall be formed (when necessary), placed, and cured in accordance with Section 03301 *Portland Cement Concrete*. The surface shall be hand finished.

D. The size, length, and bending details of reinforcement shall be as shown in the foundation slab details in the working drawings. The minimum allowable reinforcing shall be epoxy-coated #5 bars, with longitudinal spacing 16 inches on centers, and cross bar spacing 6 feet on centers. Longitudinal bars shall be placed such that they will not be cut during anchorage installation.

E. A minimum of 7 calendar days prior to beginning work, the Contractor shall deliver to the Engineer 3 copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type of impact attenuator being installed.

F. ASTM Type III (Class B), Type V (Class C), or Type IX (Class E) sheeting directly applied to plastic or aluminum sheeting, or other lightweight rigid material, shall be affixed to the front cylinder, module, or front face of the impact attenuator. The pattern and color of the reflectorization shall be as indicated in the contract documents or as per Sections 730.01 and 730.05 of the NYSDOT Standard Specification.

G. If no dimensions are provided, the panel shall be approximately square with a minimum of 18 inches on a side (24 inches on Inertial Barrier Modules). Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing v-shaped striping, 4 inches wide, alternating between reflectorized yellow and opaque non-reflectorized black stripes, as indicated for Type 3 Object Markers in the MUTCD, Manual on Uniform Traffic Control Devices.

H. When traffic will be permitted on only one side, the pattern shall be diagonal 4 inch stripes, downward sloping to the side on which traffic is to be permitted.

I. The Contractor shall install the appropriate standard transition piece(s). If a transition is needed, but there is no standard transition design, a manufacturer's approved special transition piece, subject to the Engineer's approval, shall be furnished and installed.

J. Prior to installing impact attenuators and appurtenances or excavating for concrete pad, the exact location of underground utilities that may conflict with the attenuator shall be determined. Location adjustments to eliminate conflict shall be approved by the Engineer.

K. Damage to utilities due the performance of the work shall be located and repaired at no cost to the Authority.

END OF SECTION

SECTION 02854

IMPACT ATTENUATORS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings and Catalog Cuts for Impact Attenuators.

B. Manufacturers Working Drawings for each Attenuator as described in 3.01 of this Section

C. Certification from the Attenuator supplier stating that the attenuators meet the requirements of the Contact Drawings.

END OF APPENDIX "A"

DIVISION 2

SECTION 02892

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW JERSEY)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies environmental requirements for excavation, storage, transportation, and off-site disposal of soil materials.

B. The method of disposal shall be removal off-site for ultimate disposal. Soil reuse will not be allowed at the site.

C. The Work of this Section shall be performed according to applicable New Jersey Department of Environmental Protection (NJDEP) regulations.

1.02 DEFINITIONS

A. "Disposal" shall mean the removal of the excavated materials from the construction site and placement of any contaminated soils at facilities with valid permits from NJDEP, the U.S. Environmental Protection Agency (USEPA), or the state within which the disposal facility is located.

B. "Excavated Materials Storage Area" shall mean the area(s) designated by the Engineer at the construction site where excavated soil is temporarily placed for waste classification.

C. "Non-hazardous Soils and materials" shall mean soils and other materials which include, but not limited to, soil, cuttings, debris, clay, silt and organic materials that would be considered non-hazardous when the following criteria are met:

1. The contaminant levels are below the most stringent clean-up levels established by NJDEP.
2. The waste is not classified as a hazardous waste. The non-hazardous soil would be classified as an ID 10 or ID 27 for treatment, storage or disposal purposes.

D. "Solid Waste Facility" (SWF) shall mean any system, site, equipment or building that is utilized for the storage, collection, processing, transfer, transportation, separation, recycling or disposal of non-hazardous soil and other materials.

1.03 REGULATORY REQUIREMENTS

A. In addition to the requirements of the Section of the Specification entitled "Laws and Ordinances" of Division 1 - GENERAL PROVISIONS, comply with all applicable provisions of the following:

1. Environmental Protection Agency (USEPA) Regulations: 40 CFR Part 261 - Hazardous Waste Management.
2. Department of Transportation (USDOT) Regulations: 49 CFR Part 171 - Hazardous Materials Transportation.

3. State of New Jersey Department of Environmental Protection (NJDEP) Regulations: N.J.A.C. 7:26 (1) and (8) - Solid and Hazardous Waste Management.

4. Occupational Safety and Health Administration (OSHA) Regulations: 29 CFR 1910.120 - Safety and Health for Construction.

B. Where the requirements of this Section of the Specifications and the above regulations differ, the stricter requirement shall control.

C. Reference in this Section to laws, codes, ordinances, regulations, standards, or other Federal, State, municipal, local or other departmental legal requirements shall be deemed to mean the latest version or revision thereof or successor thereto, notwithstanding any change in numbering, designation or titles.

1.04 WORK AREA CONDITIONS

A. Throughout the Work of this Section, representatives of NJDEP or USEPA may be present at the construction site. The Contractor shall cooperate with such representatives as directed by the Engineer.

B. If required in Appendix A of this Section, a Safety Officer shall be present at the site at all times of performance of Work of this Section.

C. A NJDEP-licensed site remediation professional (LSRP) and NJDEP certified laboratory shall be utilized, as applicable, for activities required in this Section.

1.05 QUALITY ASSURANCE

A. The Contractor shall hold current, valid off-site transportation permits stipulated in Appendix B of this Section.

B. Employ for work of this Section workers trained in accordance with OSHA 29 CFR 1926.32(e).

C. If required in Appendix A of this Section, the Safety Officer designated for Work of this Section shall hold the following current, valid certifications:

1. First Aid and Cardiopulmonary Resuscitation (CPR).
2. Completion of OSHA (29 CFR 1910.120 (e) (4)) Training or EPA Training Course 165.5 entitled "Hazardous Materials Incidental Response Operations".
3. Completion of OSHA (29 CFR 1910.120 (e) (4)) Management and Supervisor Training.

D. In addition to the requirements of the Section of Division 1 - GENERAL PROVISIONS entitled "Safety Provisions", the Contractor shall provide for Work of this Section a site specific Health and Safety Plan (HASP). Such plan shall conform to the requirements of OSHA 29 CFR 1910.120 (d)(4) and shall, at a minimum:

1. Be reviewed and approved by a certified industrial hygienist, and read and signed by all affected personnel.
2. Identify key personnel responsible for site safety, including the name and qualifications of the Safety Officer.
3. Address level of personnel protection to be employed during Work, setting forth specific criteria for choices of protective clothing and equipment.
4. Identify, provide location and telephone number of, route to, and list arrangements with the nearest medical facility.

5. Set forth procedures for decontamination of personnel, materials and equipment, and procedures for the sampling and disposal of decontamination wastes.

E. The disposal facility utilized by the Contractor for receipt of materials transported from the site shall hold current valid permits and licenses as stipulated in Appendix B to this Section - "Transportation and Disposal Requirements for Excavated Materials".

1.06 SUBMITTALS

A. Within five (5) calendar days after receipt by him of the acceptance of his Proposal, the Contractor shall submit to the Engineer the following for approval:

1. In accordance with 1.05 A. herein, submit evidence of current valid permits for the entity performing off-site transportation.
2. In accordance with 1.05 B. herein, submit training certifications for all workers who will be engaged in Work of this Section.
3. In accordance with 1.05 C. herein, certification of training for the Safety Officer.
4. In accordance with 1.05 D. herein, the site-specific Health and Safety Plan (HASP) and written verification that the HASP has been reviewed and approved by a certified industrial hygienist.
5. List of names of all proposed subcontractors identifying each task to be performed by each subcontractor proposed for Work under this Section.
6. In accordance with 1.05 E. herein, name, location, contact person, telephone number and permit(s) of all facilities to be used for the disposal of non-hazardous soil materials. The submittal shall also contain copies of all permits and licenses required by Appendix B, "Transportation and Disposal Requirements for Excavated Materials", and a complete listing of any notices of violations, citations, or administrative complaints issued by any Federal, State or local agency for the facilities described.

B. Submit to the Engineer one copy of the following:

1. Executed non-hazardous waste disposal bills of lading for each load of non-hazardous soil transported from the construction site.
2. Executed non-hazardous waste disposal bills of lading signed by a responsible party of the disposal facility.

PART 2. PRODUCTS

2.01 GENERAL

A. Protective Clothing: For all personnel who will potentially be in contact with hazardous or non-hazardous soil, furnish protective work clothing and equipment in accordance with 29 CFR 1926.629(d)(2).

PART 3. EXECUTION

3.01 GENERAL

A. Materials excavated during performance of Work shall be stockpiled at a location at the construction site designated by the Engineer and as approved by the LSRP.

3.02 PREPARATION

A. Prior to starting Work of this Section, make an inspection accompanied by the Engineer to determine physical condition of adjacent existing structure(s) or construction that is to remain.

B. The Contractor shall prepare and submit to the Engineer for approval a written description of such conditions including photographic documentation when requested by the Engineer.

3.03 SOIL HANDLING AND CHARACTERIZATION

A. Excavation and stockpiling of the materials must be performed using methods that minimize the dispersion of soil into water or land.

B. The Engineer will determine whether the stockpiled soils require disposal as non-hazardous or hazardous material.

C. During the Contractor's operations, including loading and transporting the excavated soil, take all precautions that are necessary to prevent any contamination by the excavated soil of the surrounding areas. To the extent such contamination occurs as a result of the Contractor's operations, take all measures necessary to clean up the same.

D. Remove materials, prepare for off-site transportation and perform operations in accordance with Appendix A of this Section.

E. In accordance with N.J.A.C. 7:9D, Well Construction and Maintenance; Sealing of Abandoned Wells, all casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute non-hazardous waste (e.g., construction and demolition 13C waste) shall be handled in accordance with N.J.A.C. 7:26-2.1. This would include waste material resulting from construction and demolition operations, e.g., wood scrap; tree parts/stumps and brush; concrete, asphalt, masonry; building materials; ferrous and nonferrous metal; non-asbestos building insulation; plastic scrap; dirt; and other miscellaneous materials; not including other solid waste types as classified by NJDEP.

3.04 DISPOSAL OF EXCAVATED SOIL

A. Non-hazardous soil shall be disposed of at a facility having current permits and licenses as stipulated in Appendix B to this Section - "Transportation and Disposal Requirements for Excavated Materials".

B. Furnish and affix to all equipment at the time of transportation all the necessary labels and tags that are required by Federal and State agencies having jurisdiction over the transportation of non-hazardous materials.

C. Unless specifically approved in writing by the Engineer, the Contractor shall not stop enroute either before or after picking up non-hazardous soil materials from property to pick up additional material from any other party.

END OF SECTION

DIVISION 2

SECTION 02892

ENVIRONMENTAL REQUIREMENTS

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW JERSEY)

APPENDIX A

A. DESCRIPTION OF SOIL MATERIALS

1. The Engineer will determine whether the excavated soils require disposal as non-hazardous or hazardous material. Disposal of non-hazardous and hazardous soil shall be by the Contractor.

B. ADDITIONAL REQUIREMENTS

1. The Contractor shall furnish all required disposal certificates.
2. The Contractor shall stage and maintain the non-hazardous soil at location(s) designated by the Engineer and in accordance with Section 3.03 A. herein for a period not exceeding six (6) months.
3. The Contractor shall stage and manage any hazardous soil in accordance with Section 3.03 A. herein for a period not exceeding 90 days.
4. The Safety Officer is required to be present at all locations during excavation and staging of excavated materials. The Safety Officer shall also be present on-site during loading of non-hazardous soils for off-site disposal.

END OF APPENDIX "A"

DIVISION 2

SECTION 02892

TRANSPORTATION AND DISPOSAL REQUIREMENTS FOR EXCAVATED MATERIALS

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW JERSEY)

APPENDIX B

A. TRANSPORTATION AND DISPOSAL REQUIREMENTS FOR EXCAVATED MATERIALS

1. Required Registration for Transporters of Non-hazardous Soil Materials.
2. All devices used by the Contractor for the transportation of non-hazardous soil materials shall have current registrations approved by NJDEP.
3. If the Contractor proposes disposal that requires interstate transportation, then he shall comply with all applicable transportation regulations of the state(s) through or within which transportation will be made.

B. *REQUIRED PERMITS AND APPROVALS FOR SOLID WASTE FACILITIES* (SWFS).

1. Where required, SWFs used by the Contractor for the Work herein shall have current registrations and permits for operating such facilities or shall be approved by the state (and by USEPA or other local agency, if applicable) in which it operates.
2. Where required, SWFs used by the Contractor for the Work herein shall have current State Pollutant Discharge Elimination System permits.
3. The SWF proposed by the Contractor shall meet the following requirements:
   a. During the last twelve months, the SWF shall not have incurred more than five (5) Notice of Violations (NOVs) related to accepting unpermitted haulers or accepting waste containing contamination above the facility's permit limits.
   b. During the last twelve months, the SWF shall not have incurred more than three (3) Notice of Violations (NOVs) related to poor housekeeping, such as spills of chemicals or petroleum products that could contaminate soil and ground water.
   c. The SWF shall not have incurred an Administrative Consent Order (ACO) related to ground water remediation.
4. The Engineer's approval of the proposed SWF will be contingent upon verification of the SWFs *environmental compliance.*

END OF APPENDIX "B"

DIVISION 2

SECTION 02894

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW YORK)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the handling, treatment, and disposal of non-hazardous soil materials described in Appendix B to this Section.

B. The method of disposal shall be removal off-site for ultimate disposal. Soil reuse will not be allowed at the site.

1.02 DEFINITIONS

A. "RCRA" means the Resource Conservation and Recovery Act and "TSCA" means the Toxic Substance Control Act.

B. "Non-Hazardous Soils and Materials" shall mean soils and other materials which include, but not limited to, soil, cuttings, solid debris, clay, silt, sand, and organic materials that are not designated as hazardous waste".

C. "Solid Waste Facility" (SWF) means any system, site, equipment or building which is utilized for the storage, collection, processing, transfer, transportation, separation, recycling, recovering or disposal of non-hazardous soil and other materials.

D. "Disposal" shall mean the removal of non-hazardous soil materials from the site and placement of material in a SWF.

1.03 WORK AREA CONDITIONS

A. Throughout the Work of this Section, representatives of NYSDEC may be at the Area of Work. The Contractor shall cooperate with and give such assistance to such representatives as may be directed by the Engineer.

B. An environmental consulting and/or laboratory entity shall be utilized as stipulated in Appendix C to this Section.

C. If required in Appendix B of this section, a Safety Officer shall be present at the site at all times of Work of this Section. Such Safety Officer shall not be a substitute for the competent person stipulated in Division 1 hereof.

D. Display or have available at all times at the site a copy of the approved Health and Safety Plan (HASP) in accordance with 1.04 F. herein.

1.04 QUALITY ASSURANCE

A. The Contractor shall have a minimum of 3 years experience in successfully completing projects similar in size and scope to the Work under this Section.

B. The Contractor shall hold current, valid off-site transportation permits stipulated in Appendix D of this Section, and shall possess a spill prevention, countermeasures and containment plan (SPCC).

C. The Contractor shall conduct its operations for Work of this Section in accordance with the environmental consulting and/or laboratory entity report as stipulated in Appendix C to this Section.

D. Employ for Work of this Section, workers trained in accordance with OSHA 29 CFR 1926.21.

E. If required in Appendix B in this Section, the Safety Officer designated for Work of this Section shall hold the following current, valid certifications:

1. First Aid and Cardiopulmonary Resuscitation (CPR).
2. Completion of OSHA (29 CFR 1910.120 (e)(4)) Training or EPA Training Course 165.5 entitled "Hazardous Materials Incidental Response Operations".
3. Completion of OSHA (29 CFR 1910.120 (e)(4)) Management and Supervisor Training.

F. In addition to the requirements of the Section of Division 1 GENERAL PROVISIONS entitled "Safety Provisions", the Contractor shall provide for Work of this Section a site-specific Health and Safety Plan (HASP). Such plan shall conform to the requirements of OSHA 29 CFR 1910.120 (d)(4) including, but not limited to, the following:

1. The HASP shall be approved by a certified industrial hygienist, and read and signed by all affected personnel.
2. Identify key personnel responsible for site safety, including the name and qualifications of Safety Officer.
3. Address levels of personal protection to be employed during Work, setting forth specific criteria for choices of protective clothing and equipment.
4. Designate Work area exclusion zone(s) and decontamination zone(s) as defined by OSHA. Describe how zone(s) will be marked/barricaded and made known to all persons at this site.
5. Establish site emergency procedures, for example, escape routes, signals for evacuating work parties, emergency communications, procedures for response to fire and explosions. Describe emergency equipment to be made available on site, such as portable extinguishers, first aid kit, etc.
6. Identify, provide location of, and list arrangements with the nearest medical facility.
7. Set forth a program for air monitoring in the Work area (exclusion zone). List and describe equipment to be used.
8. Provide action levels based on air monitoring to upgrade personal protection against airborne contaminants.

9. Set forth procedures for decontamination of personnel, materials and equipment.

G. The disposal facility utilized by the Contractor for receipt of materials transported away from the site shall hold current valid permits and licenses stipulated in Appendix D to this Section.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

(Not Used)

PART 3. EXECUTION

3.01 PREPARATION

A. Prior to starting Work of this Section make an inspection accompanied by the Engineer, to determine physical condition of adjacent existing structure(s) or construction that is to remain.

B. The Contractor shall prepare and submit to the Engineer for approval a written description of such conditions including photographic documentation when requested by the Engineer.

3.02 SOIL HANDLING AND CHARACTERIZATION

A. All casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute non-hazardous waste (e.g., construction and demolition 13C waste) shall be handled in accordance with NYSDEC procedures. This would include waste material resulting from construction and demolition operations, e.g., wood scrap; tree parts/stumps and brush; concrete, asphalt; masonry; building materials; ferrous and nonferrous metal; non-asbestos building insulation; plastic scrap; dirt; and other miscellaneous materials; not including other solid waste types as classified by NYSDEC.

3.03 REMOVAL AND DISPOSAL

A. Remove material, prepare for off-site transportation and perform operations in accordance with Appendix B to this Section.

B. Perform operations with care adjacent to existing constructions that are to remain and in confined areas. Do not operate power equipment within confined areas or within 2 feet of existing constructions that are to remain. Provide protection of such constructions, and use hand removal methods at locations within 2 feet of such constructions.

C. Take all necessary precautions to prevent contamination of adjacent property and construction.

D. Unless specifically approved in writing by the Engineer, the Contractor shall not stop enroute either before or after picking up non-hazardous soil materials from Authority property to pick up additional material from any party.

END OF SECTION

SECTION 02894

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW YORK)

APPENDIX "A"

SUBMITTALS

A. Within five calendar days after the acceptance of the Proposal, the Contractor shall submit the following to the Engineer for approval:

1. In accordance with 1.04 A. Quality Assurance herein:

   a. Demonstration of a minimum of 3 years of experience, through submission of a list of prior completed projects indicating the dates of completion, names, addresses and telephone numbers of owners of projects completed.

   b. Certification that such entity has not been the subject of any legal or administrative action or proceeding brought by the United States Environmental Protection Agency (EPA), the NYSDEC, the United States Occupational Safety and Health Administration (OSHA), or any other Federal, State or local agency having safety, health or environmental responsibilities or function; or

   c. If the entity has been the subject of legal proceedings, lawsuits, claims or citations levied by any Federal, State, or local government agencies for any past or present hazardous material activities, submit a description of same, and describe how the allegations were resolved; and if the entity has been associated with hazardous material projects which have been prematurely terminated; provide a description of such projects including the circumstances surrounding the termination.

   d. The provisions contained herein shall in no way be deemed to limit or diminish the certification made by the Contractor in accordance with the clause of Information for Bidders entitled "Certification of No Indictment, Conviction, Suspension, Debarment or Termination".

2. The Contractor shall submit evidence of current valid permits issued by the NYSDEC for all methods or processes he intends to use for managing and treating non-hazardous soil materials prior to ultimate offsite disposal.

3. In accordance with 1.04 B herein, evidence of current valid permits for the entity performing off-site transportation, and a copy of the SPCC.

4. In accordance with 1.04 C herein, certification of consulting and/or laboratory entity, if required by Appendix C of this Section.

5. In accordance with 1.04 D herein, evidence of training certifications of all workers who will be engaged in Work of this Section.

6. In accordance with 1.04 E herein, evidence of training certifications of the Safety Officer.

7. In accordance with 1.04 F herein, the site specific Health and Safety Plan (HASP) and verification in writing that the HASP has been approved by a certified industrial hygienist.

8. A list of names of all proposed subcontractors, identifying the tasks to be performed by each subcontractor proposed for Work under this Section.

9. In accordance 1.04 G herein, name, location, telephone contact and permit(s) of all facilities to be used for the disposal of non-hazardous soil materials. The submittal shall also contain copies of all permits and licenses required by Appendix D and a complete listing of any notices of violations, citations, or administrative complaints issued by any federal, State, or local agency for the facilities described.

10. Inspection report in accordance with 3.01 herein.

B. Submit to the Engineer one copy of:

1. Executed non-hazardous waste manifests and/or bill-of-lading for each load of non-hazardous material removed and transported from the site, and for material associated with decontamination as stipulated in 3.03 herein.

2. Executed non-hazardous waste manifest form and/or bill-of-lading from 1.05 B.1 herein signed by a responsible party of the disposal facility.

3. Certificate of final disposal for each manifest and/or bill-of-lading.

END OF APPENDIX A

SECTION 02894

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW YORK)

APPENDIX "B"

A. Description of Non-Hazardous Soil Materials

1. All excavated materials determined via laboratory analysis to be non-hazardous by regulation shall be handled, treated and disposed of as non-hazardous materials. The excavated materials may include historic fill materials. Known of suspected contaminants in and around the area include PCBs. Lead and polynuclear aromatic hydrocarbons (PAHs).

2. The Engineer will verify any waste classification in accordance with the laboratory tests stipulated in Appendix C to this Section.

B. Additional Requirements

1. The Contractor shall provide roll-off containers or other suitable containers to place ID-27 or other non-hazardous waste soil materials.

2. The Contractor shall place the ID-27 soil in the containers and securely cover the containers when full.

3. The Contractor shall stage and maintain the soil and containers at a location designated by the Engineer for a minimum of three weeks.

4. The Contractor shall furnish all required non-hazardous waste manifest forms and/or bill-of-lading.

END OF APPENDIX B

SECTION 02894

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW YORK)

APPENDIX "C".

A. Environmental Consulting and/or Laboratory Entity

1. The Contractor will provide the services of a NYSDOH-certified laboratory entity. The Contractor will analyze one discrete soil sample for every 20 cubic yards of soil materials described in 1.0 of Appendix A to this Section. The soil materials will be analyzed for full TCLP analysis, reactivity characteristics (including quantitative results for reactive sulfide and cyanide), total petroleum hydrocarbons, total PCBs, ignitability and corrosivity characteristics, as well as other parameters that may be required for proper disposal.

END OF APPENDIX C

SECTION 02894

HANDLING, TREATMENT AND DISPOSAL OF NON-HAZARDOUS SOIL AND MATERIALS (NEW YORK)

APPENDIX "D"

A. Required Registration For Transporters Of Non-Hazardous Soil Materials:

1. All devices used by the Contractor for the transport of non-hazardous soil materials shall have current registrations approved by NYSDEC as required by New York State regulations under 6NYCRR Part 364.

2. If the Contractor proposes disposal that requires inter-state transport, then he shall comply with all applicable transport regulations of the states he will transport in.

B. Required Permits And Approvals For Solid Waste Facilities (SWFs)

1. SWFs used by the Contractor for the Work herein shall have current registrations and permits approved by NYSDEC as required by New York State regulations under 6NYCRR Part 360 for operating such facilities or, if not located in New York, approved by the state (or by the Federal EPA or other local agency if applicable) from which it operates.

2. Where required, SWFs used by the Contractor for the Work herein shall have current State Pollutant Discharge Elimination System permit.

3. The SWF proposed by the Contractor shall meet the following requirements:

   a. The SWF shall not have incurred more than five (5) Notice of Violations (NOVs) related to accepting unpermitted haulers or accepting waste containing contamination above the facility's permit limits during the last twelve months.

   b. The SWF shall not have incurred more than three (3) NOVs related to poor housekeeping during the last twelve months, such as spills of chemicals or petroleum products that contaminate soil and groundwater.

   c. The SWF shall not have incurred an Administrative Consent Order (ACO) related to groundwater remediation.

4. The Engineer's approval of the proposed SWF will be contingent upon verifying the facility's environmental compliance.

END OF APPENDIX D

DIVISION 2

SECTION 02895

DISPOSAL OF HAZARDOUS MATERIAL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for disposal of hazardous material as stipulated in Appendix A to this Section.

1.02 DEFINITIONS

A. "RCRA" means the Resource Conservation and Recovery Act and TSCA means the Toxic Substance Control Act.

B. "Hazardous material" shall be deemed to include, but is not limited to, solid debris, clay, silt, sand and organic materials contaminated as defined in the regulations of RCRA, TSCA and the New Jersey Department of Environmental Protection (NJDEP) or New York State Department of Environmental Conservation (NYSDEC) as applicable.

C. "TSDF" shall mean a federally approved and permitted treatment, storage, and disposal facility.

D. "Disposal" shall mean the removal of hazardous material from the site and placement of material on an EPA, or NJDEP or NYSDEC approved TSDF.

1.03 WORK AREA CONDITIONS

A. Throughout the Work of this Section, representatives of NYSDEC or NJDEP (as applicable) may be at the Area of Work. The Contractor shall cooperate with and give such assistance to such representatives as may be directed by the Engineer.

B. An environmental consulting and/or laboratory entity shall be utilized as stipulated in Appendix B to this Section.

C. Employ a Safety Officer as stipulated in 1.04 D. herein who shall be present at the site at all times of Work of this Section. Such Safety Officer shall not be a substitute for the competent person stipulated in Division 1 hereof.

D. Prior to start of Work at the site notify local and county health and fire officials in writing.

E. Display or have available at all times at the construction site a copy of the approved Health and Safety Plan (HASP) in accordance with 1.04 E. herein.

1.04 QUALITY ASSURANCE

A. The entity performing the Work under this Section shall have a minimum of 3 years experience in successfully completing projects similar in size and scope to the Work under this Section.

B. The entity performing the off-site transportation required for Work of this Section shall hold current valid permits stipulated in Appendix C to this Section, and shall possess a spill prevention, countermeasures and containment plan (SPCC).

C. The Contractor shall conduct its operations for Work of this Section in accordance with the environmental consulting and/or laboratory entity report as stipulated in Appendix B to this Section.

D. Employ for Work of this Section workers trained in accordance with 29 CFR 1910.120(e).

E. The Safety Officer utilized for Work of this Section shall hold the following current, valid certifications:

1. First Aid and Cardiopulmonary Resuscitation (CPR).
2. Completion of OSHA (29 CFR 1910.120 (e)(4)) Training or EPA Training Course 165.5 entitled "Hazardous Materials Incident Response Operations".
3. Completion of OSHA (29 CFR 1910.120(e)(4)) Management and Supervisor Training.

F. In addition to the requirements of the Section of Division 1 GENERAL PROVISIONS entitled "Safety Provisions" (or "Safety and Security Provisions, as applicable,) the Contractor shall provide for Work of this Section a site-specific Health and Safety Plan (HASP). Such plan shall conform to the requirements of 29 CFR 1910.120 (d)(4) including, but not limited to, the following:

1. The HASP shall be approved by a certified industrial hygienist, and read and signed by all affected personnel.
2. Identify key personnel responsible for site safety, including name and qualifications of Safety Officer.
3. Address levels of personal protection to be employed during Work, setting forth specific criteria for choices of protective clothing and equipment.
4. Designate Work area exclusion zone(s) and decontamination zone(s) as defined by OSHA. Describe how zone(s) will be marked/barricaded and made known to all persons at this site.
5. Establish site emergency procedures, for example, escape routes, signals for evacuating work parties, emergency communications, procedures for response to fire and explosions. Describe emergency equipment to be made available on site, such as portable extinguishers, first aid kit, etc.
6. Identify, provide location of, and list arrangements with the nearest medical facility.
7. Set forth a program for air monitoring in the Work area (exclusion zone). List and describe equipment to be used.
8. Provide action levels based on air monitoring to upgrade personal protection against airborne contaminants.
9. Set forth procedures for decontamination of personnel, materials and equipment.

G. The disposal facility utilized by the Contractor for receipt of materials transported away from the site shall hold current valid permits and licenses stipulated in Appendix C to this Section.

1.05 SUBMITTALS

A. Within five calendar days after the acceptance of the Proposal, the Contractor shall *submit the following to the Engineer for approval:*

1. In accordance with 1.04 A. Quality Assurance herein:
   a. Demonstration of a minimum of 3 years of experience, through submission of a list of prior completed projects indicating the dates completion, names, addresses and telephone numbers of owners of whom projects were completed.
   b. Certification that such entity has not been the subject of any legal or administrative action or proceeding brought by the United States Environmental Protection Agency (EPA), the NYSDEC, the NJDEP, the United States Occupational Safety and Health Administration (OSHA), or any other Federal, State or local agency having safety, health or environmental responsibilities or function; or
   c. If the entity has been the subject of legal proceedings lawsuits, claims or citations levied by any Federal, State, or local government agencies for any past or present hazardous material activities, submit a description of same, and describe how the allegations were resolved; and if the entity has been associated with hazardous material projects which have been prematurely terminated, provide a description of such projects including the circumstances surrounding the termination.
   d. The provisions contained herein shall in no way be deemed to limit or diminish the certification made by the Contractor in accordance with the clause of Information for Bidders entitled "Certification of No Indictment, Conviction, Suspension, Debarment or Termination".
2. In accordance with 1.04B. herein, evidence of current valid permits for the entity performing off-site transportation, and a copy of the SPCC.
3. In accordance with 1.04 C. herein, certification of consulting and/or laboratory entity, if required by Appendix B of this Section.
4. In accordance with 1.04 D. herein, evidence of training certifications of all workers who will be engaged in Work under this Section.
5. In accordance with 1.04 E. herein, evidence of training certifications of the Safety Officer.
6. In accordance with 1.04 F. herein, the site specific Health and Safety Plan (HASP).
7. A list of names of all proposed subcontractors, identifying the tasks to be performed by each subcontractor proposed for Work under this Section.
8. In accordance with 1.04 G. herein, name, location, telephone contact and permit(s) of all facilities to be used for the disposal of hazardous materials. The submittal shall also contain copies of all permits and licenses required by Appendix C and a complete listing of any notices of violations, citations, or administrative complaints issued by any federal, State, or local agency for the facilities described.
9. Inspection report in accordance with 3.01 herein.

B. Submit to the Engineer one copy of:

1. Notifications in accordance with 1.03 D. herein.

2. Executed waste manifests for each load of hazardous material removed and transported from the construction site, and manifests for material associated with decontamination as stipulated in 3.03 herein.
3. Executed waste manifest form from 1.05 B.2 herein signed by a responsible party of the landfill facility.
4. Certificate of final disposal for each manifest.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01 PREPARATION

A. Prior to starting Work of this Section make an inspection accompanied by the Engineer, to determine physical condition of adjacent existing structure(s) or construction that is to remain.

B. The Contractor shall prepare and submit to the Engineer for approval a written description of such conditions including photographic documentation when requested by the Engineer.

3.02 REMOVAL AND DISPOSAL

A. Remove material, prepare for off-site transportation and perform operations in accordance with Appendix A to this Section.

B. Perform operations with care adjacent to existing constructions that are to remain and in confined areas. Do not operate power equipment within confined areas or within 2 feet of existing constructions that are to remain. Provide protection of such constructions, and use hand removal methods at locations within 2 feet of such constructions.

C. Take all necessary precautions to prevent contamination of adjacent property and construction.

D. Unless specifically approved in writing by the Engineer, the Contractor shall not stop en route either before or after picking up of hazardous materials from Authority property to pick up additional material from any party.

3.03 DECONTAMINATION OF EQUIPMENT AND MATERIALS

A. All decontamination procedures of equipment and materials shall conform to the requirements of applicable USEPA and NYSDEC or NJDEP regulations, as appropriate.

B. Without exception, all recoverable equipment and materials which has been in contact with hazardous material, whether such are the Contractors or its subcontractors, shall be decontaminated prior to removal from the site. As used herein "recoverable" shall mean all items which are non-absorptive in nature and which can successfully be decontaminated. All items for which decontamination is difficult or uncertain shall be considered non-recoverable. Examples of such non-recoverable equipment or materials are; non-reusable personnel protective equipment and apparel, contaminated cleaning rags or waste, cleaning fluids, contaminated temporary erosion control materials, and residual contaminated soil, all as determined by the Engineer.

1. Decontamination shall take place within an on-site equipment and materials decontamination area designated by the Engineer.

2. Provide a non-porous barrier membrane of appropriate size and material under items being decontaminated to catch and hold rinse fluids and protect adjacent grade area. This barrier membrane and the rinse fluids shall be considered non-recoverable.
3. Deposit non-liquid non-recoverable materials into containers for subsequent off-site removal and disposal. Remove containers from the site when directed by the Engineer.
4. Decontaminate recoverable Contractor owned equipment and materials with pressurized steam. Do not utilize any detergent agents.
5. Soil areas adjacent to and below the materials decontamination area shall be inspected by the Engineer for residual contamination. Such residual contamination shall be removed as stipulated in Appendix A to this Section.

C. Conduct rinse fluids into DOT containers complying with 49 CFR 173 and 178.

D. Mark, placard and manifest packaged decontamination materials in accordance with federal and state regulations. Submit copies of manifest to the Engineer.

END OF SECTION

SECTION 02895

DISPOSAL OF HAZARDOUS MATERIAL

APPENDIX A

1.01 DESCRIPTION OF HAZARDOUS SOIL MATERIALS

Soil materials that are excavated in the Work area have the potential to have hazardous characteristics.

A. The Engineer will verify the waste classification of the soil materials excavated under this Section in accordance with the laboratory tests stipulated in Appendix B to this Section.

1.02 ADDITIONAL REQUIREMENTS

A. The Contractor shall provide roll-off containers or other suitable containers in which to place the potentially hazardous soil materials.

B. The Contractor shall place the potentially hazardous soil materials in the containers and securely cover the containers when full.

C. The Contractor shall stage and maintain the soil and containers at a location designated by the Engineer for a minimum of three weeks.

D. The Contractor shall furnish all required waste manifest forms.

END OF APPENDIX A

SECTION 02895

DISPOSAL OF HAZARDOUS MATERIAL

APPENDIX B

1.01 ENVIRONMENTAL CONSULTING AND/OR LABORATORY ENTITY

A. The Contractor shall be responsible for all work associated with testing the excavated materials (e.g., Full Toxicity Characteristics Leachate Procedure (TCLP) analysis, Reactive Cyanide, Reactive Sulfide, Ignitability, Corrosivity, BTEX, RCRA Metals, PCB's, and total petroleum hydrocarbons, gradation analysis, compaction testing) required by the disposal facility he chooses. The work shall include preparing a sampling plan, collecting soil samples in accordance with the latest NYSDEC and NJDEP field sampling procedures and employing a duly-certified laboratory to analyze the soil samples.

B. The Contractor shall submit his sampling plan to the Engineer for review before collecting samples for additional tests.

C. The Contractor shall submit duplicate samples of all samples collected for additional tests to the Authority.

D. Copies of the laboratory reports of the soil analysis from additional tests shall be submitted to the Engineer.

END OF APPENDIX B

SECTION 02895

DISPOSAL OF HAZARDOUS MATERIAL

APPENDIX C

1.01 REQUIRED REGISTRATION FOR TRANSPORTERS OF NON-HAZARDOUS SOIL MATERIAL:

A. All devices used by the Contractor for the transport of hazardous soil materials shall have current registrations approved by NYSDEC and/or the NJDEP under the applicable state, and – as necessary – federal regulations.

B. If the Contractor proposes disposal that requires inter-state transport, then he shall comply with all applicable transport regulations of the states he will transport in.

1.02 REQUIRED PERMITS AND APPROVALS FOR SOLID WASTE FACILITIES (SWFs)

A. Where required, SWFs used by the Contractor for the Work herein shall have current registrations and permits approved by NYSDEC and/or NJDEP as required by applicable state regulations for operating such facilities or, if not located in New York or New Jersey, approved by the state (or by the Federal EPA or other local agency if applicable) from which it operates.

B. Where required, SWFs used by the Contract for the Work herein shall have current State Pollutant Discharge Elimination System permit.

C. The SWF proposed by the Contractor shall meet the following requirements:

1. The SWF shall not have incurred more than five (5) Notice of Violations (NOVs) related to accepting unpermitted haulers of accepting waste containing contamination above the facility's permit limits during the last twelve months.
2. The SWF shall not have incurred more than three (3) NOVs related to poor housekeeping during the last twelve months, such as spills of chemicals or petroleum products that contaminate soil and groundwater.
3. The SWF shall not have incurred an Administrative Consent Order (ACO) related to groundwater remediation.

D. The Engineer's approval of the proposed SWF will be contingent upon verifying the facility's environmental compliance.

END OF SECTION

DIVISION 2

SECTION 02896

DISPOSAL OF WASTE GENERATED DURING REMOVAL OF LEAD BASED PAINT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for Disposal of material described in 1.0 of Appendix A to this Section.

B. References in this Section to laws, codes, ordinances, regulations, standards or other federal, State, municipal, local and departmental legal requirements shall be deemed to mean the latest version or revision thereof, or successor thereto, notwithstanding any change in numbering, designation of titles.

1.02 DEFINITIONS

A. "RCRA" means the Resource Conservation and Recovery Act and "TSCA" means the Toxic Substance Control Act.

B. "Hazardous material" is a solid waste as defined in the RCRA regulations of 40 CFR 261.2 and 261.3, TSCA, New York State Department of Environmental Conservation (NYSDEC) under 6 NYCRR Part 571, or the New Jersey Department of Environmental Protection (NJDEP), as appropriate.

C. "TSDF" shall mean a federally approved and permitted treatment, storage, and disposal facility as defined in 40 CFR Part 264.

D. "Disposal" shall mean the removal of waste from the construction site and placement of material in an EPA approved TSDF or recycled in an EPA and consignment State approved secondary smelter.

1.03 CONSTRUCTION SITE CONDITIONS

A. Throughout the Work of this Section, representatives of the Environmental Protection Agency (EPA) or NYSDEC may be at the construction site and the Area of Work. The Contractor shall cooperate with and give such assistance to such representatives as may be directed by the Engineer.

B. An environmental consulting and/or laboratory entity shall be utilized as stipulated in Appendix B to this Section.

C. The competent person stipulated in the Section of Division 1 entitled "Safety Provisions" shall be present at the construction site at all times of Work of this Section.

1.04 QUALITY ASSURANCE

A. The entity performing the public highway transportation under this Section shall have a minimum of 3 years experience in successfully completing projects similar in size and scope to the Work under this Section, shall hold valid permits stipulated in 1.0 of Appendix C to this Section, and shall possess a spill prevention, countermeasures and containment plan (SPCC).

B. Conduct the Disposal operations of this Section at the construction site in accordance with the environmental consulting and/or laboratory entity reports as stipulated in Appendix B to this Section.

C. The TSDF if utilized by the Contractor for receipt of Hazardous Materials shall be a site listed in Appendix D of this Section, or a facility with valid permits and licenses stipulated in Appendix C to this Section and approved by the Engineer prior to commencement of Work of this Section.

D. The secondary smelter if used by the Contractor for thermal recovery recycling of Hazardous Material shall hold valid EPA and consignment State approval for treatment of waste listed by EPA as D008.

1.05 SUBMITTALS

A. Prior to starting the Work of this Section submit the following to the Engineer for approval:

1. In accordance with 1.04 A. Quality Assurance herein:

   a. Demonstration of a minimum of 3 years of experience, through submission of a list of prior completed projects indicating the dates of completion, names, addresses and telephone numbers of owners of whom projects were completed.

   b. Certification that such entity has not been the subject of any legal or administrative action or proceeding brought by the United States Environmental Protection Agency (EPA), the NYSDEC, the United States Occupational Safety and Health Administration (OSHA), or any other Federal, State or local agency having safety, health or environmental responsibilities or function; or

   c. If the entity has been the subject of legal proceedings lawsuits, claims or citations levied by any Federal, State, or local government agencies for any past or present activities, submit a description of same, and describe how the allegations were resolved; and if the entity has been associated with projects which have been prematurely terminated, provide a description of such projects including the circumstances surrounding the termination.

   d. The provisions contained herein shall in no way be deemed to limit or diminish the certification made by the Contractor in accordance with clause(s) of Information for Bidders.

   e. Evidence of valid permits for the entity performing off-site transportation, a copy of the SPCC, and information on Department of Transportation (DOT) reportable accidents and environmental reportable incidents.

2. In accordance with 1.04 B. herein, certification of consulting and/or laboratory entity, if such entity is required to be employed by the Contractor in accordance with by Appendix B of this Section.

3. In accordance with 1.04 C. and 1.04 D. herein, not less than 20 calendar days prior to transportation of any waste material from the construction site, submit names, locations (address and consignment states), telephone contacts and permit(s) of all facilities to be used for the Disposal of materials. The submittal shall also contain copies of all permits and licenses required by Appendix C of this Section and a complete listing of all notices of violations, citations, or administrative complaints issued by any Federal, state, or local agency for such designated facilities.

a. Submit names, locations (address and consignment states), telephone contacts and permit(s) of all facilities to be used for the disposal of hazardous waste and materials. The submittal shall also contain copies of all permits and licenses required by Appendix C of this Section and a complete listing of all notices of violations, citations, or administrative complaints issued by any Federal, State, or local agency for such designated facilities.

b. For recycled material, submit a fully executed copy of the recycle facility Acceptance Aproval Certificate issued to the Contractor.

4. If recycled steel grit abrasives are used by the Contractor, submit the Contractor's proposed stabilization method that complies with 40 CFR 268.42, Table

B. Submit to the Engineer one copy of:

1. Executed and signed waste manifest for each load of waste material removed and transported for the Authority designated personnel indicated on such forms.
2. Executed waste manifest form (parts 5 and 6) from 1.05 b.3 herein signed by a responsible party.
3. Certificate of final disposal for each manifest or certificate of recycling for recycled material.
4. Weekly inspection log of hazardous waste storage area.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01 REMOVAL AND DISPOSAL

A. Prepare and perform transportation operations from the construction site in accordance with Appendix A, Appendix B and Appendix C to this Section.

B. Take all necessary precautions to prevent contamination of the construction site and adjacent property.

C. Within the Area Available for Contractor's Use set aside a specific area for the storage of hazardous waste, and store hazardous waste generated during each of the working shifts only within this specific area.

D. At the completion of the Work, prepare for disposal and dispose of the crushed stone and the preformed plastic membrane used within the Area Available for Contractor's Use as follows:

1. Collect the stone in a sieving device which is also used to wash off any residual materials attached to the stone during the performance of the Work.
2. Filter the washwater runoff using 5 micron filter and collect effluent from this operation in the DOT approved drums/containers. Dispose the effluent according to the procedures stipulated in Appendix A to this Section.

3. Dispose the washed stone in a commercial solid waste disposal site.
4. Roll up the preformed plastic membrane and dispose of as stipulated in Appendix A to this Section.

E. Unless specifically approved in writing by the Engineer, stopping enroute either before or after pick up of Hazardous Materials is prohibited.

END OF SECTION

DIVISION 2

SECTION 02896

DISPOSAL OF WASTE GENERATED DURING REMOVAL OF LEAD BASED PAINT

APPENDIX A

1.01 DESCRIPTION OF MATERIALS

A. Work of this Contract will generate the following types of waste:

1. Rinseate water from water blasting operation
2. Washwater from cleaning of Staging Area
3. Spent abrasive and paint debris
4. Dust from HEPA-vaccumed locations
5. Sediments and filters from rinseate water cleaning.

The Authority is the Generator of waste associated with Work of this Contract and will provide the EPA Identification Number to the Contractor for disposal purposes.

1.02 DISPOSAL REQUIREMENTS

A. Furnish and construction site deliver DOT approved lined roll-off containers, and label and mark in accordance with 49 CFR 172, 173, 178 and 179.

B. Collect different types of waste in separate containers or drums labeling them "LEAD CONTAINING WASTE".

C. Before sealing drums or containers, collect samples for testing in accordance with Appendix B to this Section.

D. Transport spent abrasive and debris generated at the construction site which tested as non-hazardous in accordance with Appendix B of this Section, using public highway transportation, and dispose of as commercial solid waste in accordance with Appendix B of this Section, in an EPA designated land disposal site conforming to the requirements of 40 CFR 243 and 268, or at the Contractor's option, at an EPA approved secondary smelter facility.

E. Transport spent abrasive and debris generated at the construction site which tested as hazardous solid waste in accordance with Appendix B of this Section, using public highway transportation, and dispose of in an EPA designated facility listed in Appendix D of this Section, or conforming to the requirements of 40 CFR 260, 264, 265, 266, 268 and 270 and approved by the Engineer, or at the Contractor's option, at an EPA approved secondary smelter facility.

F. Rinseate water shall be tested and disposed of in accordance with 1.0 C. of Appendix B.

1.03 ADDITIONAL REQUIREMENTS

A. The Contractor shall furnish all required Federal, or consignment or generator State manifest forms.

B. Upon completion of operations each Work Period, haul routes shall be cleaned, at no additional cost to the Authority.

C. Accumulate hazardous waste in accordance with applicable requirements of 40 CFR 262.30 through 34 (packaging, labeling, marking, placarding, accumulation time) and 6 NYCRR 373-2.9 performing weekly inspection of storage area. Submit weekly inspection log to the Engineer.

D. The accumulation time may not exceed 90 days, and the 90-days period begins when 1,000 kg of hazardous waste has been accumulated (6 NYCRR 372.2(a)(8)(ii) and 40 CFR 262.34(a)).

E. Prior to transportation from the construction site, furnish and prepare all manifest forms and furnish and affix to all vehicles all labels, tags and placards required by federal and state agencies having jurisdiction over the transportation of materials by carrier over public highways.

F. Transport in accordance with the requirements of 49 CFR 171, 172, and 177 and notify the TSDF in accordance with 1.0B. of Appendix B to this Section.

END OF APPENDIX "A"

DIVISION 2

SECTION 02896

DISPOSAL OF WASTE GENERATED DURING REMOVAL OF LEAD BASED PAINT

APPENDIX B

1.01 ENVIRONMENTAL CONSULTING AND/OR LABORATORY ENTITY

A. The Authority, or an environmental consulting and/or laboratory entity employed by the Authority, will use EPA or state approved sampling procedures and will perform Toxicity Characteristic Leaching Procedure (TCLP) testing of representative samples of removed paint debris generated at the construction site.

B. Based on such test results, the Engineer will direct the supply of containers and the removal of the material from the construction site as stipulated in 2.0A, 2.0B. and 2.0 C. of Appendix A of this Section.

1. When spent abrasive or paint debris tests non-hazardous (TCLP test results which indicate lead concentration from 1 to less than 5.0 ppm), the Contractor shall notify the TSDF that the waste contains lead, and the material shall be treated or stabilized to TCLP lead level below 1 part per million prior to landfill Disposal.
2. *Hazardous Material (TCLP test results equal to or greater than 5.0 ppm) shall be* treated and stabilized to TCLP lead level below 1 part per million prior to Disposal.
3. When recycled steel grit abrasives are used and the resulting waste tests non-hazardous, the TSDF shall be notified by the Contractor that the waste contains lead and further stabilization to TCLP lead level below 1 part per million is required prior to Disposal.

C. Rinseate water collected during any water blasting operations at the bridge, and washwater runoff from crushed gravel washing operations shall be tested by an independent testing laboratory certified to perform work in the State of New York or the State of New Jersey, as appropriate, and approved by the Engineer. Submit laboratory test results of chemical constituent characteristics to the Engineer for determination of the appropriate disposal method, and once authorized dispose of rinseate.

END OF APPENDIX "B"

DIVISION 2

SECTION 02896

DISPOSAL OF WASTE GENERATED DURING REMOVAL OF LEAD BASED PAINT

APPENDIX C

1.01 REQUIRED PERMITS FOR TRANSPORTERS OF MATERIAL:

For Work in the States of New Jersey and New York, a New Jersey or New York Hazardous Waste Hauler Permit, as applicable.

1.02 PERMITS AND LICENSES REQUIRED FOR THE DISPOSAL FACILITY(IES):

A. Notification of Hazardous Waste Activities submitted pursuant to the Resource Conservation and Recovery Act (RCRA).

B. EPA Treatment, Storage, and Disposal Facility (TSDF) identification numbers obtained pursuant to RCRA.

C. EPA approval for chemical waste landfill including copy of RCRA TSDF permit, if applicable.

D. State and local permits for chemical waste landfill facility and any additional State permits for TSDF operations if applicable and the State is administering RCRA for the EPA.

E. Federal or State Pollutant Discharge Elimination System permit, for operations at TSDF, if applicable.

END OF APPENDIX "C"

DIVISION 2

SECTION 02896

DISPOSAL OF WASTE GENERATED DURING REMOVAL OF LEAD BASED PAINT

APPENDIX D

Listed below are Authority approved treatment, storage and disposal facilities for hazardous wastes:

APPROVED FINAL DISPOSAL FACILITIES FOR

PAINT DEBRIS

APTUS Incorporation:
Aragonite, Utah (801)531-4273
Coffyville, Kansas (316) 251-6380

Ash Grove Cement:
Cadence Chanute, Kansas (316) 431-4500

Browning Ferris Industries:
Poland, Ohio (216) 536-8013

Chemical Waste Management:
Model City, New York (716) 754-8231
Newark, New Jersey (201) 465-9100
Fort Wayne, Indiana (219) 447-5585
Carlyss (Lake Charles), Louisiana
(313) 583-2169
West Carrollton, Ohio (517) 859-6101

Chem-Met Services, Inc.:
Wyandott, Michigan (313) 282-9250

City Environmental:
Detroit, Michigan (313) 923-0080

Coplay Cement:
Logansport, Indiana (219) 753-5121

Dixie Cement (Cadence):
Knoxville, Tennessee
(713) 653-6861

Dupont Chambers Works:
Deepwater, New Jersey (609) 299-5000

ENSA, Indiana:
South Bend, Indiana (219) 255-7957

ENSCO:
El Dorado, Arkansas (501) 863-7173

Environmental Enterprises, Inc.:
Cincinatti, Ohio (513) 772-2818

Envirite Coporation
York Pennsylvania (717) 846-1900

ESI (Fondessy Enterprises, Inc.):
Oregon, Ohio (419) 698-3500

Exide Corporation:
Reading, Pennsylvania (610) 378-9353

EWR:
Coal City, Illinois (815) 634-2211

Giant Resource Recovery:
Harleyville, S.C. (803) 496-5033

GSX of South Carolina:
Pinewood, S.C. (803) 452-5003

Heritage Environmental Services:
Indianapolis, Indiana (317) 243-0811

Keystone Portland Cement:
Bath, Pennsylvania (610) 837-2240

Modern Landfill:
Buffalo, New York (800) 662-0012

Northeast Environmental Services:
Wampsville, New York (315) 697-3979

S & W Waste
Kearny, New Jersey (201) 344-4004

Safety Kleen:
Hebron, Ohio (614) 929-3532
Clayton, New Jersey (609) 861-2526
Woodside, Queens (718) 429-0657

Thermal Kem:
Rockhill, S.C. (803) 324-5310

Thermal Oxidation Corp.:
Roebuck, S.C. (803) 576-1085

U.S. Ecology
Beaty, Nevada (702) 557-2203

Valley Landville:
Irwin, Pennsylvania (412) 744-7446

Wayne Disposal Co.:
(RCRA landfill only)
Belleville, Michigan (313) 697-2200

END OF APPENDIX "D"

DIVISION 2

SECTION 02897

CONTAMINATED MATERIALS MANAGEMENT

PART 1. GENERAL

1.01 DESCRIPTION

A. Manage contaminated materials (regulated non-hazardous or hazardous waste) - generated by and/or encountered during excavation of soil/historic fill and excavation dewatering activities - in accordance with all applicable codes, rules and regulations, including but not limited to those listed under Part 1.03 of this section. The Contractor will be required to manage any waste streams generated (e.g., contaminated soil, debris, historic fill, storm water and / or ground-water - with or without free-floating petroleum) during the anticipated activities (e.g., pier excavations, approaches' constructions, roadway constructions, etc.) and other related Work activities at both the NJ and NY sides. The Contractor will be required to manage (test, load, transport, and reuse or dispose) the contaminated materials (e.g., Petroleum-, PCBs-, and Metal- contaminated soil, potential radiological-material contaminated soils, underground petroleum storage tank (UST) closures and associated soil remediation, etc.) from other areas of concern at both the Authority-owned and Non-Authority-owned properties.

B. The Work shall consist of managing contaminated materials - that is testing and characterization; on-site or off-site re-use; off-site disposal/recycling facility and regulatory approvals; and loading, transportation, and disposal/recycling of regulated waste. Storage and handling of the materials generated (e.g., excavating and stockpiling soils, pumping and storing water in tank or appropriate containers, etc.) is part of the related specifications. Currently anticipated waste streams include: petroleum, PCBs and metal-contaminated non-hazardous soil and/or debris, historic fill, and excavation water (i.e., storm or ground water) with or without free-floating petroleum, and potential radiological-material contaminated soils.

C. The procedures and descriptions included in this section constitute the minimum technical requirements for managing contaminated materials. No information included in this document should be construed as final. Revisions or changes in regulations or guidance documents pertaining to managing regulated wastes should be taken into consideration and implemented, as appropriate.

1.02 RELATED SECTIONS

A. 02050 Demolition and Disposal

B. 02081 Asbestos Removal and Disposal

C. 02095 Containment, Worker & Environmental Protection

D. 02145 Dewatering

E. 02260 Special Excavation Requirements

F. 02892 Handling Treatment and Disposal of Non-Hazardous Soil Materials NJ

G. 02894 Handling Treatment and Disposal of Non-Hazardous Soil Materials NY

H. 02895 Disposal of Hazardous Materials

I. 02896 Disposal of Waste Generated During Removal of Lead-based Paint

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) requirements including applicable regulation and guidance documents available at NJDEP Website http://www.nj.gov/dep/srp/

   a. NJDEP Alternative and Clean Fill Guidance

   b. NJDEP Linear Construction Guidance

   c. NJPDES Discharge to Surface Water (DSW) Permit

   d. NJDEP Forms available at http://www.nj.gov/dep/srp/srra/forms/

2. New Jersey Administrative Code (NJAC) listed below

   a. NJAC, Title 7, New Jersey Pollution Prevention Program Rules

   b. NJAC, Title 7, New Jersey Spill Control Regulations

   c. NJAC, Title 7, New Jersey Surface Water Quality Standards

   d. NJAC, Title 7, New Jersey Storm Water Management Rules

   e. NJAC, Title 7, New Jersey Solid and Hazardous Waste Management Act

   f. NJAC, Title 7, Chapter 26, New Jersey Air Pollution Control Laws

   g. NJAC Title 7, Chapter 27, New Jersey Regulations on Toxic Substances

   h. NJAC Title 7, Chapter 29 1.1 - 2.12, New Jersey Noise Control Regulations

   i. NJAC, Title 8, Chapter 62, New Jersey Department of Health, Standards for Lead Certification

   j. NJAC, Title 12, Chapter 120, Safety and Health Standards

   k. NJAC, Title 13, New Jersey Solid Waste Management Act

   l. NJAC, Title 58, Chapter 10 B, New Jersey Hazardous Discharge Site Remediation

   m. NJAC, Title 58, New Jersey Water Pollution Control Act

   n. NJAC, Title 5, Chapter 17, New Jersey Lead Hazard Evaluation and Abatement Code

   o. NJAC, 7:26E the Technical Requirements for Site Remediation

   p. NJAC, 7:26C the Administrative Requirements for the Remediation of Contaminated Sites rules.

3. NEW YORK STATE DEPARTMENT OF TRANSPORTATION

"New York State Department of Transportation Standard Specifications, Construction and Materials" dated January 2, 2002 with current metric additions and modifications.

NOTE: In the Various subsections of the NYSDOT Standard Specifications referenced in this specification, references to "The Department" shall be taken to mean the Authority, references to "The Regional Construction Engineer", or "Deputy Chief Engineer" shall be taken to mean the Engineer.

4. NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

NOTE: Below referenced information pertaining to Laws, Rules, Regulations & Guidance Documents included in this specification should not be construed as final. Revisions or changes in NYSDEC regulations or guidance documents which are mentioned herein or which became effective after this document was written should be taken into consideration and implemented, as appropriate.

a. NYSDEC Regulations Part 598 Handling and Storage of Hazardous Substances §598.10 Closure and Change of Service;

b. Memorandum from NYSDEC, Division of Spills & Responses, Permanent Closure of Petroleum Storage Tanks, dated January 20, 1987, Modified July 19, 1988 and December 3, 2003;

c. Draft DER-10 Technical Guidance for Site Investigation and Remediation December 25, 2002 (DER-10 Guidance);

d. Memorandum from NYSDEC Division of Spills and Response modified version as of December 3, 2003;

e. SPOTS Memo# 14, Site Assessments at Bulk Storage Facilities, Dated August 1, 1994;

f. STARS #1 – Petroleum-Contaminated Soil Guidance Policy;

g. TAGM # 3028 – "Contained In" Criteria for Environmental Media: Soil Action Levels (August 1997);

h. TAGM # 4046 – "Determination of Soil Cleanup Objectives and Levels (and subsequent clarifying memoranda issued by DER);

i. Pre-Proposal Draft 6NYCRR Part 364 Waste Transporters dated June 2006;

j. Title 10, Part 73, New York State Code of Rules and Regulations, Asbestos Safety Program Requirements, promulgated August 13, 1987, effective September 3, 1988;

k. Title 12, Part 56, Rules and Regulations of the State of New York, promulgated July 8, 1987; effective December 15, 1987; amended January 1, 1992 and November 9, 1994.

5. City of New York Laws and Regulations, including but not limited to:

a. New York City Local Law 70, 1985, Chapter 31, Title A New York City Administrative Code as amended by Local Laws 21 and 80, 1987; approved November 25, 1985; currently in effect;

b. New York City Department of Sanitation Regulations in Relation to Transport, Storage and Disposal of Hazardous Waste, promulgated November 26, 1986; effective December 30, 1986.

6. Occupational Safety and Health Administration (OSHA) Regulations, including, but not limited to:

a. United States Department of Labor, Occupational Safety and Health Act Standards, 29 Code of Federal Regulations (CFR) Part 1910.20, 1910.134, 1910.145, 1910.1001, 1910.1200, and 1926 Subpart C, 1926.1101;

b. Title 40 CFR, Subchapter 1, Solid Wastes (Parts 260 through 268);

c. United States Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAPS) 40 CFR 61;

d. Title 49, CFR Part 171, Hazardous Substances; Part 172, Hazardous Materials Tables and Hazardous Materials Communications Regulations, Subpart B and C; Part 173, Shippers - General Requirements for Shipments and Packaging;

e. Environmental Conservation Law Article 27, enacted 1972; most recently amended December 1, 1987;

f. 6NYCRR Part 360, Solid Waste Management Facilities and Associated Buildings, as amended, effective April 1, 1987;

g. Part 364, New York State Code of Rules and Regulations, Waste Transporter Rules, effective January 10, 1985; revised December 30, 1985.

B. Miscellaneous Federal Regulations and Standards

1. United States Department of Transportation (USDOT) Standards.

PART 2. PRODUCTS AND MATERIALS

2.01 PERMITS AND NOTIFICATIONS

A. Notify the following agencies for the regulated waste transport in accordance with all applicable laws, codes, rules, and regulations:

New York State DEC
Bureau of Solid Waste, Reduction and Recycling
625 Broadway
Albany, New York 12233-7253

B. Secure all necessary permits, licenses and/or certifications in conjunction with regulated waste handling, removal, hauling and disposal and timely notification of such actions, as may be required by Federal, State, Regional and Local Authorities. Provide the Engineer with copies of all required permits and notifications before the start of the Work.

C: Obtain from the insurance carrier for the Contractor and /or the Hazardous Waste Subcontractor, as applicable, the approval of all regulated waste transport Work of this Contract as "Scheduled Project(s) " and provide the Engineer with written documentation thereof.

D. Proof that a permitted disposal and/or recycling site has been located and arrangements for transport and disposal of regulated waste Materials have been made. Provide the name, location and of copies of all permits of the disposal facility and waste transport company, as applicable.

E. Upon receipt of all applicable permits, approvals and notifications hereunder, the Engineer shall issue a permit to the Contractor authorizing him to proceed with the transport Work. Comply with all Authority notification requirements for notifying nearby persons and/or building occupants prior to transport activity.

F. Pursuant to Section 364.2 of the Waste Permit requirements (NYSDEC Regulations Part 364).

1. No person shall, except pursuant to and in accordance with a valid permit issued pursuant to this Part:

   a. Collect or remove any regulated waste from its point of origin, generation or occurrence;

   b. Transport any regulated waste;

   c. Deliver any regulated waste to a treatment, storage or disposal facility or otherwise dispose of or relinquish possession of any regulated waste other than specified in such permit;

2. No person who owns or operates a facility at, or premises on, which any regulated waste originates, is generated, or occurs, shall deliver or otherwise relinquish possession of such waste except to a person who has a valid permit issued pursuant to this Part.

3. The transporter of regulated waste shall not be required to obtain a permit pursuant to this Part if the transporter has contracted with a generator of such waste who has been issued a valid permit pursuant to this Part, provided that:

   a. The transporter is designated on the generator's waste transporter permit as a waste transporter contracted to transport the generator's regulated waste;

   b. The transporter does not transport any regulated waste other than those specified on the generator's permit while operating under the provisions of such permit; and

   c. The transporter does not dispose of, deliver or otherwise relinquish possession of any generator's regulated waste to any place other than that designated in the generator's permit.

2.02 CONTRACTOR HEALTH AND SAFETY

A. Prepare a site-specific Health and Safety Plan (HASP) for the Work of this Section. Such plan shall take into account the confinement and height of the Work Areas; and shall be prepared by the Contractor's Certified Industrial Hygienist (CIH) and submitted to the Engineer for review and approval. This HASP shall address the specific components of this Section. The HASP shall include, but not be limited to, the following:

1. Health and Safety Responsibility Plans.

2. Site Health and Safety Plans.

a. Guidelines on reassessing the Site HASP.

3. Site Control:

a. Certification:

(1) General Site Personnel Training Requirements.

(2) Site Manager and Site Health and Safety Manager Training Requirements.

(3) Medical Monitoring Requirements.

b. Conformance with the Site HASP by Contractor, Subcontractors, and visitors.

c. HASP Communication.

d. Site specific medical surveillance program.

e. General requirements for Work Area definition and limited access.

f. Incident reporting requirements.

g. Specific requirements for decontamination.

h. Specific requirements for emergency planning and contingency plans.

4. USEPA's Level of Protection descriptions and usage requirements.

5. Contractor's Respiratory and Personal Protective Equipment (PPE) Programs: Selection and usage specifications..

6. Contractor's Hazard Communication Program.

7. Standard Field Safety Procedures.

PART 3. EXECUTION

3.01 MATERIALS HANDLING

A. The Contractor or its Subcontractor (s) shall perform all Work necessary to carry out the proper handling, storage, classification, transportation and disposal of all regulated waste in accordance with all applicable Federal, State and Local laws, codes, rules and regulations; and in accordance with the requirements of this Section.

1. The intent of this Section is to specify the proper handling and disposal of regulated waste associated with the Work.

2. Assume that all soils and debris will likely be classified as petroleum contaminated non-hazardous waste as defined as applicable regulations. Any regulated waste containing materials encountered during the Work at the Site shall be properly disposed of in accordance with all applicable Federal, State and local laws, codes, rules and regulations and the requirements of these Specifications.

3. Field verify all quantities and locations of the regulated waste materials which will require further disposal.

B. The Work of this Section shall be performed as stated herein. No variances may be obtained or invoked other than those specifically cited herein.

C. Dispose of all regulated materials at an approved disposal or recycling center in accordance with all applicable laws, codes, rules and regulations. A completed waste manifest/waste shipment record shall be provided to the Engineer within 30 days from the time the waste is hauled from the Work site.

D. If the Contractor uses Subcontractor(s) to perform any of the regulated waste Work under this Section, Specifications shall apply to the Subcontractor(s) as if specifically referred to herein.

1. Prior to using any other Subcontractor(s) to perform any of the hazardous waste Work under this Section, including transporting Work, submit an executed Statement of Qualification For each such Subcontractor to the Engineer for his review and written approval.

2. The Contractor's use of Hazardous Waste Transporters Subcontractor(s) shall not relieve the Contractor of full responsibility for the Work to be performed. Nothing provided herein shall create any relationship in contract or otherwise between the Contractor's Subcontractor(s) and the Authority. Further, nothing herein shall create any rights to any third party nor obligation on the part of the Authority to any third party.

E. Coordinate the waste transport schedule with the Engineer for his approval.

F. Comply with all applicable laws, codes, rules and regulations including, but not limited to, the requirements stated herein. References to laws, codes, rules, regulations, standards, or other Federal, State, local, and Authority requirements shall be deemed to mean the latest version or revision thereof, or successor thereto, notwithstanding any change in numbering or designation to titles.

3.02 REMOVAL AND DISPOSAL

A. Remove and dispose of all regulated waste materials generated in the Work Area and enumerated in this Specification.

B. Protect against spill contamination.

C. All waste haulers shall be fully permitted for transporting regulated waste. Verify that the haulers adhere to all applicable laws, codes, rules and regulations in relation to Transport, Storage and Disposal of hazardous waste.

D. Provide a Site Supervisor during the transport project. Meet supervision, training and manpower requirements as defined in the Specifications and all applicable laws, codes, rules and regulations.

E. Provide 24 hours notice and receive approval from the Engineer, should the Work schedule change for any reason.

F. Shipping Containers: Impermeable containers shall be suitable to receive and retain any regulated waste materials until they are disposed of at an approved recycling facility. The containers shall be labeled in accordance with this Section. Containers shall be both airtight and watertight and conform to USDOT Standard 49 CFR 178.224. Each container shall be constructed of metal, with locking, air tight lids.

G. Markings and Labels: Shipping containers shall bear danger labels, transportation packaging labels, and generator identification information. Labels shall be permanently affixed to the trucks in accordance with OSHA Standard 29 CFR 1926.1101(k)(2), USDOT Standard 49 CFR Part 171 and 172, and EPA Standard 40 CFR Part 61.150(a)(1)(v).

1. Danger label format and color shall conform to OSHA Standard 29 CFR 1926.200. Danger labels shall display the following legend/information:

DANGER
CONTAINS REGULATED or HAZARDOUS WASTE

2. Generator identification information shall be affixed to each USDOT label format and color shall conform to USDOT Standard 49 CFR 172.304. Generator identification information labels shall display the following legend/information:

GENERATOR'S NAME:
GENERATOR'S 24 HOUR PHONE:
GENERATOR'S FACILITY ADDRESS:

H. Warning Signs: Warning Signs shall be posted at the perimeter of the Work area prior to transport operations in accordance with OSHA Standard 29 CFR 1926.1101. Danger sign format and color shall conform to OSHA Standard 29 CFR 1926.200. The signs shall display the legend indicated below:

DANGER
REGULATED or HAZARDOUS WASTE
AUTHORIZED PERSONNEL ONLY

3.03 EQUIPMENT

Equipment provided under this Section shall conform to applicable Federal, State and local laws, codes, rules, regulations, and the requirements specified herein.

A. Communications Equipment: Devices suitable for site communications, such as "walkie-talkies" or "radio band" communicators shall be provided.

B. Vehicles: Trucks or Vans used for the transportation of regulated non-hazardous or hazardous waste shall be enclosed and suitable for loading, temporary storage, transit, and unloading of such waste without exposure to persons or property.

C. Fall Protection Equipment: Certified and approved equipment to be used by trained personnel when working at a high elevation to protect against falling.

D. Fire Extinguisher: Type "ABC" dry chemical extinguisher or a combination of several extinguisher of NFPA recommended types for the fire hazard exposures in each extinguisher location shall be provided. Minimum size of extinguisher shall be 4-A, and 40-B: C. Supply a minimum of one extinguisher for every vehicle.

3.04 VEHICLES

1. The operator of any vehicle used for activities covered by this Part shall carry the original permit or a legible photocopy of such permit in the vehicle. The operator shall present the permit, together with shipping or transporting documents relative to the waste being transported, to authorized representatives of the department or to any law enforcement officers when requested to do so.

2. A permittee shall display the full name of the transporter on both sides of each vehicle and the trans porter's permit number in figures at least three inches high and of a color which contrasts with the background, in a prominent position on each side and the rear of each vehicle used for activities covered by this Part.

3. The operator of any vehicle used for activities covered by this Part shall remain with such vehicle while it is being filled or discharged.

4. All wastes must be properly contained during transport so as to prevent leaking, blowing, or any other type of discharge into the environment.

5. A permittee shall submit a report on forms prescribed by the department. A permittee shall retain for three years the records on which such reports are based, and shall make such records available, upon request, to the department during normal business hours.

6. A permittee and the operator of any vehicle used for activities covered by this Part shall comply with all applicable State and federal laws and all rules and regulations promulgated thereunder. The permittee is responsible for all requirements for all vehicles including leased vehicles operated under his permit.

7. A permittee shall conspicuously mark or placard every vehicle, in a manner consistent with applicable State and Federal transportation laws and any rules and regulations promulgated thereunder and any related federal requirements, related to the transportation of the regulated waste and its principal hazard.

8. Permitted vehicles shall be restricted to the transportation of materials not intended for human or animal consumption or for other use by the general public except when properly cleaned in accordance with all applicable federal and state regulations governing decontamination.

9. Permits are not transferable. Changes of ownership invalidate the provisions of such permits. Any change of address, name or location of garaged vehicles must be submitted immediately to the department.

END OF SECTION

DIVISION 2

SECTION 02897

CONTAMINATED MATERIALS MANAGEMENT

APPENDIX A

SUBMITTALS

1.01 SUBMITTALS

Engineer approval is required for submittals, unless otherwise directed. The following shall be submitted:

A. Prior to Work Submittal

1. Materials Handling Plan: Fifteen days prior to Work, submit to the Engineer for approval a material handling plan that describes phases of dealing with the contaminated or hazardous soil, debris, and water as it relates to the proposed Work, including methods for sampling and testing requirements. Describe methods, means, equipment, sequence of operations and schedule to be employed in handling, transport, and disposal of materials.

2. Describe field sampling methods and quality control procedures. Identify laboratory, analytical methods, and testing protocol to be used. Testing reports shall show sample identification for location, date, time, sampling and analytical method, name of individual sampler, identification and certifications of laboratory, and quality control procedures and results.

3. The Materials Handling Plan shall include a comprehensive Spill and Discharge Control Plan. The Plan shall provide contingency measures for potential spills and discharge from handling and transportation of waste materials.

B. During Work Submittal:

1. Schedule of Work Changes: Any changes in the Schedule of Work proposed by the Contractor shall be submitted to the Engineer for review and approval no later than seven days prior to the commencement date of the proposed change. A revised schedule indicating actual occurrences shall be submitted at the end of each week when delays occur or proposed milestones are not met.

2. Results of all testing performed by the Contractor shall be provided within 24 hours after receipt of laboratory testing reports.

3. A certified, signed, and completed copy of each "Waste Shipment Record" form used, and receipts from the disposal and recycling facility which acknowledge the Contractor's delivery(s) of material, shall be submitted to the Engineer within three days following transport from the Site.

C. Pre-final Deliverables:

1. Copies of a daily log showing the date(s) and time(s) of entrance to and exit from the Work Area(s) for all persons.

2. Compilation of all completed and signed Waste Shipment Record forms, bills of lading, uniform hazardous waste manifest, or disposal receipts pertaining to this project.

END OF APPENDIX A

DIVISION 2

SECTION 02910

LANDSCAPE PROTECTION DURING CONSTRUCTION (NEW YORK)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for maintenance and protection of existing landscape plants and irrigation system during construction.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Perform landscape protection and maintenance operations using materials and methods in accordance with this Specification and Contract Drawings.

B. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

C. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Road, Suite 101, Londonderry, NH 03053.

D. As a guide to determine local weather predictions use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

E. Mulch shall conform to current standards established by the Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 201114245.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Do not perform any product application if precipitation has fallen within 2 hours prior to planned application, or is forecasted during the next 12-hour period.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Verify that the entity performing the Work of this Section shall employ workers experienced in landscape protection and landscape maintenance and shall have engaged in Work similar to the requirements of this Section for a period of at least five years.

2. Verify that the entity performing location of protection fencing and pruning of this Section is a ISA Certified Arborist and a member of the International Society of Arboriculture and State Chapter where they are residing.

3. Verify that the Contractor has an ISA Certified Arborist (NY) available within (24) twenty-four hours upon request.

   a. Verify that the entity performing the Work of this Contract has a New York Certified Arborist on staff who possesses a minimum of the following:

      (1) *Associates Degree in Horticulture from a recognized college.*

      (2) A total of five (5) years of work experience.

      (3) A member of the International Society of Arboriculture (ISA) and State Chapter where they are residing.

      (4) Qualified by International Society of Arboriculture during the year(s) this individual is working on this Contract.

   b. Quality Assurance

      (1) Qualifications: Verify that the entity performing the Work of this Contract utilizes the services of an ISA Certified Arborist (NY) who shall act as superintendent for tree protection and maintenance of all trees for this Contract and shall be on site at all times including but not limited to: demarcating the Primary Root Zone (PRZ), with the Engineer prior to installation of landscape protection fencing, verifying the landscaping to be protected, mulching, application of bio-stimulants to all trees, pruning, irrigation, and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to a construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with these specifications shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these specifications.

C. Specific Requirements for Operations and Products

1. Trees, Shrubs and Ground Cover

   a. The Contractor shall protect all existing landscaping during the Work of this Contract. In the event that any existing landscaping and irrigation is damaged or destroyed, the Contractor shall replace in kind with materials and workmanship equal to or better than the existing materials, at no expense to the Authority.

   b. The Contractor and his ISA Certified Arborist shall coordinate all arrangements and accompany the Engineer on all inspections of the trees, shrubs and ground cover to be protected. Provide a minimum of 48 hours prior notice to the Engineer. Do not perform any construction work around any existing landscape to be protected prior to inspection by the Engineer.

c. Prior to starting any work the Contractor's ISA Certified Arborist shall demarcate the Primary Root Zone (PRZ) with stakes around the trees, shrubs and ground cover to be protected.

d. Verify that the Contractor has erected a "landscape protection fence" protecting the PRZ of all trees, shrubs and ground cover to be protected. Prior to starting any work.

e. Once the landscape protection fence is in place, the Contractor shall not enter, store any equipment or supplies, damage or diminish the health and vigor of the tree/landscape within the area to be protected.

e. Provisions shall be made to protect the root systems of all trees within the construction site. Under no circumstances shall vehicles, heavy equipment, or material stockpiling be allowed within the drip line of protected trees. PRZ fencing and posts shall be erected by the Contractor around all existing trees to remain.

g. If a tree limb, root or part hinders a proposed construction activity, the Contractor and the Contractor's NY Certified Arborist shall arrange with the Engineer, for an inspection and recommendation on how to proceed. Under no circumstances shall the Contractor or his crew, break off or cut any tree parts. Absolutely no tree work is to be undertaken without the prior approval of the Engineer.

2. Irrigation

a. Verify that the Contractor has contacted and has performed a field verification of all existing irrigation systems in the area of Work with the Maintenance Unit Supervisor, JFK Garden & Housekeeping (718) 244-3622.

b. The Contractor shall erect and maintain a protection fence, protecting the irrigation system throughout the duration of the Contract Work, at no expense to the Authority.

c. The Contractor shall ensure that the existing irrigation system is operational throughout the growing season and that any damage at any time. The Contractor shall replace and repair with matching material and workmanship within one week of sail damage, all at no expense to the Authority.

3. Drive/Walk Through Site Inspections

a. During the installation and maintenance period the Contractor's New York Certified Arborist along with the Contractor shall be available to perform bi-weekly drive and walk through site inspections of the construction site, accompanied by the Engineer, identifying the status of the work, issues or problems requiring immediate action by the Contractor or items affecting the Contractor's work.

b. Within 48 hours of each site inspection, the Contractor's ISA Certified Tree Arborist shall submit a report listing individuals who attended the site inspection, the item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products in a legal manner.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Bio-Stimulants

1. Bio-Stimulant shall be a dry, water soluble root growth stimulant with nitrogen-fixing, phosphorus solubilizing and growth promoting bacteria packaged in ¼ pound (114 grams), pre-measured packs conforming to the following:

Ingredients:	% by Weight
Humates and Humic Acid	40%
Cold-Water Sea-Kelp Extract	35%
Essential Amino Acids (18)	7%
Sucrose and other Natural Sugars	6%
Citric Acid	5%
Vitamins and Growth Factors	2% (including B1, B2, B6, B12, Biotin, Folic Acid, Niacin and Vitamin K)
Nitrogen Fixing Bacteria	Approx. 60 Billion per Pound
Phosphorus Solubilizing Bacteria	Approx. 60 Billion per Pound
Growth Promoting Bacteria	Approx. 60 Billion per Pound
12% Potassium (K2O) derived from Humate and Kelp Extracts	

2. Bio-Stimulant shall be "PHC BioPak Water Soluble Powder" as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, or an approved equal.

B. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

C. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

D. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:

   a. Constructed of ultra-violet light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.

   b. Each TreeGator bag to have a 20 gallon water capacity and weigh 1 ½ pounds empty.

   c. Each tree shall have a minimum number of bags based on the following:

Caliper size tree	Number of TreeGator bags
1" – 4"	1
4" – 10"	2
10" – 18"	3
18"+	4

2. TreeGator portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187 or approved equal.

E. Primary Root Zone (PRZ) Fencing

1. 48" rolled, medium weight extruded polymeric mesh grid fabric of high density polyethylene, fully stabilized for ultraviolet resistance; temperature range –60 degrees F to 180 degrees F; tensile strength 2600 psi. Mesh 1 ½". Color Forest Green.

2. Painted steel u-posts. Color to match fabric. Post height 6 feet.

PART 3. EXECUTION

3.01 PREPARATION

A. Landscape Protection Measures

1. The Contractor's ISA Certified Arborist (NY) shall demarcate the PRZ around existing landscaping with stakes. Upon the approval of the Engineer, install PRZ fencing prior to commencing any construction activity.

2. Comply with 1.04 of this section at all times.

3. For pruning, conform to 3.03 D of this Section.

B. Irrigation Protection Measures

1. The Contractor shall coordinate, erect and maintain a protection fence, protecting the irrigation system throughout the duration of the Contract Work in accordance with 1.04 C. 2. of this section.

3.02 WORK PERFORMED

A. Grade Changes

1. Do not change the grade around existing trees, shrubs or ground cover unless otherwise shown on the Contract Drawings.

B. Demolition and Excavation

1. When trenching for utility lines or demolishing existing paved surfaces, subsurfaces, etc. the Contractor shall use hand labor or an airspade to excavate within the PRZ.
2. When continuous footings for curbs, fences or other structures are shown, the Contractor shall bridge the area occupied by any tree roots immediately adjacent to and within the dripline of existing trees.
3. When installing underground utilities within the dripline of a tree, airspading shall be used instead of trenching to reduce the extent of root damage.
4. Do not cut tree roots during excavation.
5. Prior to completion of each days work around tree roots, protect the tree roots from damage, drying and freezing by placing burlap, shredded hardwood bark mulch on top of the tree roots.

C. Landscaping and Irrigation Affected By Construction Activity

1. All existing trees, shrubs, ground cover and irrigation within and adjacent to the Work area shall be regularly monitored by the Contractor's ISA Certified Arborist (NY) on a bi-weekly basis.
2. All trees within and adjacent to the Work area shall be pruned as needed and receive two applications of Bio-Stimulant. One at the time the protection fence is installed and the second immediately prior to closing over the soil/root area with new paving and /or finished grade.
3. All trees within and adjacent to the Work area shall be irrigated on a regular basis in accordance with Appendix 'B'.

3.03 ADJUSTMENTS

A. Bio-Stimulant Applications

1. The Contractor shall provide two (2) applications of Bio-Stimulants to all existing trees to be maintained under this Contract in accordance with 3.03 C 2 of this Section.

2. Bio-Stimulants shall be applied under the supervision of the Contractor's ISA Certified Arborist and the Engineer.

3. Application of Bio-Stimulant as per the manufacturer's directions and as follows:

   One (1) pound of Bio-Stimulant powder per 100 gallons water.

B. Perform maintenance operations in accordance with Item B of Appendix "B" to this Section.

C. Sanitation

1. Weeding

   Maintain the landscaping within the "PRZ", "weed-free" at all times.

2. Litter Removal

   Maintain the landscaping within the "PRZ" free of litter or debris of any type at all times.

3. PRZ fence removal

   Remove the PRZ after all construction activity has been completed.

D. Pruning

1. Prune in accordance with the National Arborist Association's ANSI A300 "Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices" and in accordance with Appendix "B" and as follows:

   a. Perform pruning with sharp tools. Disinfect tools by dipping in alcohol at the commencement of the day's operation and again after finishing each plant known to be diseased. Use fresh alcohol each day for this operation.

   b. Prune to remove dead, weak, interfering, suckered, damaged or unsightly twigs or branches.

2. Prune to maintain the species' characteristic shape. Pollard and tree topping shall not be allowed.

3. No tree climbing permitted. For trees less than 15 feet in height, use free standing ladders and do not touch the tree trunk.

4. Do not disturb utility lines during pruning operations.

5. Do not use anvil-type, pruning tools.

6. Make pruning cuts at the branch collar. Crushed, jagged cuts or cuts leaving too much stub and existing improper cuts shall be properly re-cut.

7. Carefully clean and shape large wounds.

8. Remove remnants, including, but not limited to stumps, trunk, limbs, branches, and foliage. Removed remnants shall be disposed of as expeditiously as possible and in an approved manner.

I. Irrigation

1. Frequency will vary depending on environmental factors. The total amount of water, from natural or applied irrigation shall be not less than one inch per week.

2. The Contractor shall be required to irrigate all existing trees within the "PRZ" during construction with TreeGator bags if the existing irrigation system is not operating in the Work area.

3. The contractor shall remove all TreeGator bags when the PRZ fence is removed or when the existing irrigation system is fully operable within the PRZ.

4. In the event, that the Engineer, in his sole opinion determines that the Contractor has failed to water the plantings according to these Specifications, he will notify the Contractor who, at his own expense, shall immediately make corrections as directed by the Egineer. In the event that the plants die due to lack of water, the Contractor shall replace the plants with materials and workmanship that match the existing at no cost to the Authority.

J. Arborist's Site Inspections/Reports

1. The Contractor's ISA Certified Arborist (NY) along with the Contractor shall be available to perform bi-weekly drive and walk through site inspections of the construction site, accompanied by the Engineer, identifying the status of the work, issues or problems requiring immediate action by the Contractor or items affecting the Contractor's work. Site inspection frequency shall be as follows:

   Bi-weekly Site Inspections

2. Within 48 hours of each site inspection, the Contractor's ISA New York Certified Arborist shall submit to the Engineer a Maintenance Inspection Report, to include but not be limited to: list of inspection attendees, the item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

END OF SECTION

SECTION 02910

LANDSCAPE PROTECTION DURING CONSTRUCTION (NEW YORK)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of " Shop Drawings, Catalog cuts and Samples " of Division 1 - General Provisions:

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit evidence of the Entity's membership to the International Society of Arboriculture and State Chapter where they are residing.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications in writing for approval by the Engineer of the New York Certified Arborist performing the Work in accordance with 1.04 A.4 of this Section. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the Entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A of this Section. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section, and evidence of license of pesticide applicator.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit the following:

   a. A complete "Product List", listing all products to be used under this Section;

C. Specific Requirements for Operations and Products

1. Prior to any work within or adjacent to existing landscaping or irrigation systems.

   a. Submit verification that the PRZ was identifed, staked and fenced to protect existing trees, shrubs and groundcover within the Work area.

   b. Submit verification that the existing irrigation system was identified and protected within the Work area.

2. During construction within and adjacent to existing landscaping or irrigation systems.

   a. Submit verification that the PRZ and the existing irrigation system was maintained and or repaired according to these specifications.

   b. Submit verification identifying which existing trees had Work performed by the Contractor within the PRZ zone and that all appropriate actions required by this Section were performed to the satisfaction of the Engineer.

D. Certified Arborist's Inspection Reports

1. Within 48 hours notice of siting "PRZ" the Contractor shall notify the Engineer and await approval by the Engineer prior to erecting the fence and proceeding with said work.

2. Within 48 hours of each site inspection, the Contractor's ISA Certified Arborist shall submit to the Engineer an inspection report, to include but not be limited to the following: List of inspection attendees, the item(s) discussed, a brief description of maintenance issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

E. Certifications

1. Submit to the Engineer, certification required by 1.04 of this Section.

END OF APPENDIX "A"

SECTION 02910

LANDSCAPE PROTECTION DURING CONSTRUCTION

APPENDIX "B"

A. Maintenance To Be Performed While Plants are protected

Function	Schedule	Description
Irrigation-(Manual & Tree Gator Bags)	April, May, Oct. & Nov. June, July, Aug. & Sept.	Water once per week. Water twice per week.
Weed Removal	April – November	Identify/remove once/week
Litter Removal	January - December	Once a week
Bio-Stimulant Applications:		Two Applications
		1st at time construction fence is installed.
		2nd just prior to time pavement or finished grade is set.
Pruning – Deciduous Trees	January - December	Prune damaged twigs/branches. All pruning operations shall be supervised by NY Certified Arborist.
NY Certified Arborist's Walk-thru Site Inspections	April – December	Twice per month.
	January – March	Once per month (Certified Arborist's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "B"

DIVISION 2

SECTION 02911

LANDSCAPE PROTECTION DURING CONSTRUCTION (NEW JERSEY)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for maintenance and protection of existing landscape plants and irrigation system during construction.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Perform landscape protection and maintenance operations using materials and methods in accordance with this Specification and Contract Drawings.

B. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

C. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Road, Suite 101, Londonderry, NH 03053.

D. As a guide to determine local weather predictions use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

E. Mulch shall conform to current standards established by the Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 201114245.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Do not perform any product application if precipitation has fallen within 2 hours prior to planned application, or is forecasted during the next 12-hour period.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Verify that the entity performing the Work of this Section shall employ workers experienced in landscape protection and landscape maintenance and shall have engaged in Work similar to the requirements of this Section for a period of at least five years.

2. Verify that the entity performing location of protection fencing and pruning of this Section is a ISA Certified Arborist and a member of the International Society of Arboriculture and State Chapter where they are residing.

3. Verify that the Contractor has an ISA Certified Tree Expert (NJ) available within (24) twenty-four hours upon request.

   a. Verify that the entity performing the Work of this Contract has a New Jersey Certified Tree Expert on staff who possesses a minimum of the following:

      (1) Associates Degree in Horticulture from a recognized college.

      (2) A total of five (5) years of work experience.

      (3) A member of the International Society of Arboriculture (ISA) and State Chapter where they are residing.

      (4) Qualified by International Society of Arboriculture during the year(s) this individual is working on this Contract.

   b. Quality Assurance

      (1) Qualifications: Verify that the entity performing the Work of this Contract utilizes the services of an ISA Certified Tree Expert (NJ) who shall act as superintendent for tree protection and maintenance of all trees for this Contract and shall be on site at all times including but not limited to: demarcating the Primary Root Zone (PRZ), with the Engineer prior to installation of landscape protection fencing, verifying the landscaping to be protected, mulching, application of bio-stimulants to all trees, pruning, irrigation, and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to a construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with these specifications shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these specifications.

C. Specific Requirements for Operations and Products

1. Trees, Shrubs and Ground Cover

   a. The Contractor shall protect all existing landscaping during the Work of this Contract. In the event that any existing landscaping and irrigation is damaged or destroyed, the Contractor shall replace in kind with materials and workmanship equal to or better than the existing materials, at no expense to the Authority.

   b. The Contractor and his ISA Certified Tree Expert (NJ) shall coordinate all arrangements and accompany the Engineer on all inspections of the trees, shrubs and ground cover to be protected. Provide a minimum of 48 hours prior notice to the Engineer. Do not perform any construction work around any existing landscape to be protected prior to inspection by the Engineer.

c. Prior to starting any work the Contractor's ISA Certified Tree Expert (NJ) shall demarcate the Primary Root Zone (PRZ) with stakes around the trees, shrubs and ground cover to be protected.

d. Verify that the Contractor has erected a "landscape protection fence" protecting the PRZ of all trees, shrubs and ground cover to be protected. Prior to starting any work.

e. Once the landscape protection fence is in place, the Contractor shall not enter, store any equipment or supplies, damage or diminish the health and vigor of the tree/landscape within the area to be protected.

e. Provisions shall be made to protect the root systems of all trees within the construction site. Under no circumstances shall vehicles, heavy equipment, or material stockpiling be allowed within the drip line of protected trees. PRZ fencing and posts shall be erected by the Contractor around all existing trees to remain.

g. If a tree limb, root or part hinders a proposed construction activity, the Contractor and the Contractor's NY Certified Arborist shall arrange with the Engineer, for an inspection and recommendation on how to proceed. Under no circumstances shall the Contractor or his crew, break off or cut any tree parts. Absolutely no tree work is to be undertaken without the prior approval of the Engineer.

2. Irrigation

a. Verify that the Contractor has contacted and has performed a field verification of all existing irrigation systems in the area of Work with the Maintenance Unit Supervisor, JFK Garden & Housekeeping (718) 244-3622.

b. The Contractor shall erect and maintain a protection fence, protecting the irrigation system throughout the duration of the Contract Work, at no expense to the Authority.

c. The Contractor shall ensure that the existing irrigation system is operational throughout the growing season and that any damage at any time. The Contractor shall replace and repair with matching material and workmanship within one week of sail damage, all at no expense to the Authority.

3. Drive/Walk Through Site Inspections

a. During the installation and maintenance period the Contractor's New Jersey Certified Tree Expert along with the Contractor shall be available to perform bi-weekly drive and walk through site inspections of the construction site, accompanied by the Engineer, identifying the status of the work, issues or problems requiring immediate action by the Contractor or items affecting the Contractor's work.

b. Within 48 hours of each site inspection, the Contractor's ISA NJ Certified Tree Expert shall submit a report listing individuals who attended the site inspection, the item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products in a legal manner.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Bio-Stimulants

1. Bio-Stimulant shall be a dry, water soluble root growth stimulant with nitrogen-fixing, phosphorus solubilizing and growth promoting bacteria packaged in ¼ pound (114 grams), pre-measured packs conforming to the following:

Ingredients:	% by Weight
Humates and Humic Acid	40%
Cold Water Sea Kelp Extract	35%
Essential Amino Acids (18)	7%
Sucrose and other Natural Sugars	6%
Citric Acid	5%
Vitamins and Growth Factors	2% (including B1, B2, B6, B12, Biotin, Folic Acid, Niacin and Vitamin K)
Nitrogen Fixing Bacteria	Approx. 60 Billion per Pound
Phosphorus Solubilizing Bacteria	Approx. 60 Billion per Pound
Growth Promoting Bacteria	Approx. 60 Billion per Pound
12% Potassium (K2O) derived from Humate and Kelp Extracts	

2. Bio-Stimulant shall be "PHC BioPak Water Soluble Powder" as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, or an approved equal.

B. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

C. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

D. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:

   a. Constructed of ultra-violet light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.

   b. Each TreeGator bag to have a 20 gallon water capacity and weigh 1 ½ pounds empty.

   c. Each tree shall have a minimum number of bags based on the following:

Caliper size tree	Number of TreeGator bags
1" – 4"	1
4" – 10"	2
10" – 18"	3
18"+	4

2. TreeGator portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187 or approved equal.

E. Primary Root Zone (PRZ) Fencing

1. 48" rolled, medium weight extruded polymeric mesh grid fabric of high density polyethylene, fully stabilized for ultraviolet resistance; temperature range –60 degrees F to 180 degrees F; tensile strength 2600 psi. Mesh 1 ½". Color Forest Green.

2. Painted steel u-posts. Color to match fabric. Post height 6 feet.

PART 3. EXECUTION

3.01 PREPARATION

A. Landscape Protection Measures

1. The Contractor's ISA Certified Tree Expert (NJ) shall demarcate the PRZ around existing landscaping with stakes. Upon the approval of the Engineer, install PRZ fencing prior to commencing any construction activity.

2. Comply with 1.04 of this Section at all times.

3. For pruning, conform to 3.03 D of this Section.

B. Irrigation Protection Measures

1. The Contractor shall coordinate, erect and maintain a protection fence, protecting the irrigation system throughout the duration of the Contract Work in accordance with 1.04 C. 2. of this Section.

3.02 WORK PERFORMED

A. Grade Changes

1. Do not change the grade around existing trees, shrubs or ground cover unless otherwise shown on the Contract Drawings.

B. Demolition and Excavation

1. When trenching for utility lines or demolishing existing paved surfaces, subsurfaces, etc. the Contractor shall use hand labor or an airspade to excavate within the PRZ.
2. When continuous footings for curbs, fences or other structures are shown, the Contractor shall bridge the area occupied by any tree roots immediately adjacent to and within the dripline of existing trees.
3. When installing underground utilities within the dripline of a tree, airspading shall be used instead of trenching to reduce the extent of root damage.
4. Do not cut tree roots during excavation.
5. Prior to completion of each days work around tree roots, protect the tree roots from damage, drying and freezing by placing burlap, shredded hardwood bark mulch on top of the tree roots.

C. Landscaping and Irrigation Affected By Construction Activity

1. All existing trees, shrubs, ground cover and irrigation within and adjacent to the Work area shall be regularly monitored by the Contractor's ISA Certified Tree Expert (NJ) on a bi-weekly basis.
2. All trees within and adjacent to the Work area shall be pruned as needed and receive two applications of Bio-Stimulant. One at the time the protection fence is installed and the second immediately prior to closing over the soil/root area with new paving and /or finished grade.
3. All trees within and adjacent to the Work area shall be irrigated on a regular basis in accordance with Appendix 'B'.

3.03 ADJUSTMENTS

A. Bio-Stimulant Applications

1. The Contractor shall provide two (2) applications of Bio-Stimulants to all existing trees to be maintained under this Contract in accordance with 3.03 C 2 of this Section.

2. Bio-Stimulants shall be applied under the supervision of the Contractor's ISA Certified Tree Expert (NJ) and the Engineer.

3. Application of Bio-Stimulant as per the manufacturer's directions and as follows:

   One (1) pound of Bio-Stimulant powder per 100 gallons water.

B. Perform maintenance operations in accordance with Item B of Appendix "B" to this Section.

C. Sanitation

1. Weeding

   Maintain the landscaping within the "PRZ", "weed-free" at all times.

2. Litter Removal

   Maintain the landscaping within the "PRZ" free of litter or debris of any type at all times.

3. PRZ fence removal

   Remove the PRZ after all construction activity has been completed.

D. Pruning

1. Prune in accordance with the National Arborist Association's ANSI A300 "Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices" and in accordance with Appendix "B" and as follows:

   a. Perform pruning with sharp tools. Disinfect tools by dipping in alcohol at the commencement of the day's operation and again after finishing each plant known to be diseased. Use fresh alcohol each day for this operation.

   b. Prune to remove dead, weak, interfering, suckered, damaged or unsightly twigs or branches.

2. Prune to maintain the species' characteristic shape. Pollard and tree topping shall not be allowed.

3. No tree climbing permitted. For trees less than 15 feet in height, use free standing ladders and do not touch the tree trunk.

4. Do not disturb utility lines during pruning operations.

5. Do not use anvil-type, pruning tools.

6. Make pruning cuts at the branch collar. Crushed, jagged cuts or cuts leaving too much stub and existing improper cuts shall be properly re-cut.

7. Carefully clean and shape large wounds.

8. Remove remnants, including, but not limited to stumps, trunk, limbs, branches, and foliage. Removed remnants shall be disposed of as expeditiously as possible and in an approved manner.

I. Irrigation

1. Frequency will vary depending on environmental factors. The total amount of water, from natural or applied irrigation shall be not less than one inch per week.

2. The Contractor shall be required to irrigate all existing trees within the "PRZ" during construction with TreeGator bags if the existing irrigation system is not operating in the Work area.

3. The contractor shall remove all TreeGator bags when the PRZ fence is removed or when the existing irrigation system is fully operable within the PRZ.

4. In the event, that the Engineer, in his sole opinion determines that the Contractor has failed to water the plantings according to these Specifications, he will notify the Contractor who, at his own expense, shall immediately make corrections as directed by the Engineer. In the event that the plants die due to lack of water, the Contractor shall replace the plants with materials and workmanship that match the existing at no cost to the Authority.

J. Arborist's Site Inspections/Reports

1. The Contractor's ISA Certified Tree Expert (NJ) along with the Contractor shall be available to perform bi-weekly drive and walk through site inspections of the construction site, accompanied by the Engineer, identifying the status of the work, issues or problems requiring immediate action by the Contractor or items affecting the Contractor's work. Site inspection frequency shall be as follows:

   Bi-weekly Site Inspections

2. Within 48 hours of each site inspection, the Contractor's ISA Certified Tree Expert (NJ) shall submit to the Engineer a Maintenance Inspection Report, to include but not be limited to: list of inspection attendees, the item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

END OF SECTION

SECTION 02911

LANDSCAPE PROTECTION DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of " Shop Drawings, Catalog Cuts, and Samples " of Division 1 - General Provisions:

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit evidence of the Entity's membership to the International Society of Arboriculture and State Chapter where they are residing.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications in writing for approval by the Engineer of the New Jersey Certified Tree Expert performing the Work in accordance with 1.04 A.4 of this Section. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the Entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A of this Section. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section, and evidence of license of pesticide applicator.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit the following:

   a. A complete "Product List", listing all products to be used under this Section;

C. Specific Requirements for Operations and Products

1. Prior to any work within or adjacent to existing landscaping or irrigation systems.

   a. Submit verification that the PRZ was identifed, staked and fenced to protect existing trees, shrubs and groundcover within the Work area.

   b. Submit verification that the existing irrigation system was identified and protected within the Work area.

2. During construction within and adjacent to existing landscaping or irrigation systems.

   a. Submit verification that the PRZ and the existing irrigation system was maintained and or repaired according to these specifications.

   b. Submit verification identifying which existing trees had Work performed by the Contractor within the PRZ zone and that all appropriate actions required by this Section were performed to the satisfaction of the Engineer.

D. Certified Arborist's Inspection Reports

1. Within 48 hours notice of siting "PRZ" the Contractor shall notify the Engineer and await approval by the Engineer prior to erecting the fence and proceeding with said work.

2. Within 48 hours of each site inspection, the Contractor's ISA Certified Tree Expert (NJ) shall submit to the Engineer an inspection report, to include but not be limited to the following: List of inspection attendees, the item(s) discussed, a brief description of maintenance issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

E. Certifications

1. Submit to the Engineer, certification required by 1.04 of this Section.

END OF APPENDIX "A"

SECTION 02911

LANDSCAPE PROTECTION DURING CONSTRUCTION

APPENDIX "B"

A. Maintenance To Be Performed While Plants are protected

Function	Schedule	Description
Irrigation-(Manual & Tree Gator Bags)	April, May, Oct. & Nov. June, July, Aug. & Sept.	Water once per week. Water twice per week.
Weed Removal	April – November	Identify/remove once/week
Litter Removal	January - December	Once a week
Bio-Stimulant Applications:		Two Applications
		1st at time construction fence is installed.
		2nd just prior to time pavement or finished grade is set.
Pruning – Deciduous Trees	January - December	Prune damaged twigs/branches. All pruning operations shall be supervised by NY Certified Arborist.
NY Certified Arborist's Walk-thru Site Inspections	April – December	Twice per month.
	January – March	Once per month (Certified Arborist's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "B"

DIVISION 2

SECTION 02920

SOIL TESTING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for subgrade preparation and the testing of on-site fill material prior to seeding and/or planting operations.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. As a guide to determine local weather predictions use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

B. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, Current Edition, Northeastern Regional Publication No. 493 as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Obtain soil samples only during the following weather conditions:

1. There shall be no frost in the ground and the soil temperature shall be above 32 degrees F.
2. There shall be no form of precipitation falling or forecast to fall within the next two hours. Following a period of precipitation, resume operations only after the soil has drained.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Verify that the laboratory performing the soil testing of this Section is a certified testing laboratory such as the Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850 or an approved equal in either the States of New Jersey or New York, that it has experience in soil testing for soil properties important for plant and turf management and that is capable of performing a "Technical Topsoil Evaluation" as specified in 2.01 and in accordance with Appendix B of this Section.

B. Test Requirements

1. Prior to seeding and/or planting, submit a representative sample of on-site soil material for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01. Provide the number of soil samples to the testing laboratory in accordance with 1.04 B3. No substitutions for testing parameters will be permitted.
2. Take samples only in the presence of the Engineer and at sites ready for planting operations to commence.
3. Provide a minimum of three (3) test samples representative of the range of existing soil found within areas to receive seed.
4. Allow a minimum of 2 weeks for processing soil analysis at the testing laboratory.
5. Identify the type of "crop" to be grown as "Lawn" with each test sample requisition sent to the testing laboratory in order to obtain recommendations for nutrient and pH adjustments.

C. Do not commence seeding and/or planting until the Chief of Materials Engineering has approved in writing the certified results of the soil analysis and recommendations from the approved soil testing laboratory for the representative samples and approved a report from the Contractor verifying that the Contractor has reviewed the soil analysis and will comply with the recommendations.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Soil Testing conforming to the following:

1. Soil to be tested shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass or any other undesirable material.
2. Provide a soil nutrient analysis providing the percentage Nitrogen (N), Phosphorus (P) and Potassium (K) in pounds per Acre.
3. Provide soil micronutrient analysis providing the percentage of Zinc, Copper, Manganese, Boron and Iron, in parts per million.
4. Provide a soil analysis for organic matter as determined by loss on ignition of moisture-free samples.
5. Provide soil pH range.

6. Provide soluble salts in micromhos per centimeter.
7. Soil shall be graded as follows:

PASSING	RETAINED ON	PERCENTAGE
1" screen		100%
1" screen	2 mm (No. 10) Sieve	%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

8. Provide a mechanical analysis of the portion of soil passing the 2 mm sieve, based on the mechanical analysis of the soil as determined by the Bouyoucous Hydrometer method, and shall consist of the following, based on dry (air-dried only) weight of sample:
   a. Sand min% - max%, inclusive;
   b. Silt min% - max%, inclusive;
   c. Clay min% - max%, inclusive.

9. Provide recommendations for pH adjustment, fertilization and micronutrients.

PART 3. EXECUTION

3.01 PREPARATION

A. Soil Sample(s) Taken From Areas of Changed Grades

Verify that areas of changed grades shown on the Contract Drawing have a smooth, uniform surface and finish grade elevations (excepting the addition of soil amendments) have been established.

1. Obtain grab samples for the minimum of test samples representative of the range of existing soil found within the each, separate area of existing soils to receive seed.
2. Grab sample shall be made up of a two-pound sample, each.
3. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials from the sample.
4. Implement all soil recommendations received from the soil testing laboratory.
5. Do not commence with any planting or soil related activities prior to receipt of written acceptance of the soil sample analysis and recommendations, by the Chief of Materials Engineering as per 1.04 and 2.01.

B. Soil Sample(s) Taken From Unaltered Areas

Verify that subgrade areas shown on the Contract Drawings are unaltered or undisturbed by excavation, grading or stripping operations as follows:

1. Follow steps listed in 3.01 A., 1-4 above.

END OF SECTION

SECTION 02920

SOIL TESTING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISION:

A. Qualifications

1. Submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the testing laboratory performing the Work of this Section.

B. Products

1. Submit in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS a complete "Product List", listing the product to be used under this Section, to the Engineer.
2. Submit the locations of grab samples of soil (as many as required), the individual results of the soil analyses, and the amendment recommendations to the Chief of Materials Engineering in accordance with 1.04 and 2.01.

C. Test Reports

Submit laboratory analyses of soil and the results of the "Technical Topsoil Evaluation" to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance with 1.04, 2.01 and Appendix B.

D. Certification

Submit to the Chief of Materials Engineering certification required by 1.04 A & B.

END OF APPENDIX "A"

SECTION 02920

SOIL TESTING

APPENDIX "B"

The following is a sample testing form to be used by the Contractor:

Material: Soil

Specification: Section 02920 – "Technical Topsoil Evaluation"

Crop: Lawn

Source of Sample:

Contract or P.O.#:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Nutrients: Inorganic Nitrogen-Nitrate (ppm)			
Nutrients: Inorganic Nitrogen-Ammonium (ppm)			
Total Kjeldahl Nitrogen (%)			
Nutrients: P (pounds/acre)			
Nutrients: K (pounds/acre)			
Micro Nutrients: Zinc (ppm)			
Micro Nutrients: Copper (ppm)			
Micro Nutrients: Manganese (ppm)			
Micro Nutrients: Boron (ppm)			
Micro Nutrients: Iron (ppm)			
Organic Matter: (Loss of Ignition)	Min. % Max. %		
Soluble Salts: - Micromhos/Cm - PPM	Max. Max.		
pH:			
Mechanical Analysis: Passing - 1"	100%		
Passing - 1" Retain 2 mm (#10)	Max. % The portion retained shall be no larger than 3/8" in size and shall be composed of homogeneous clods and/or stones		
Passing 2mm (#10)	Min. %		

Retain Pan			
Bouyoucous Hydrometer Test of Material:			
Passing 2 mm (#10) Percent - Sand	min%-max%		
Percent – Silt	min%-max%		
Percent – Clay	min%-max%		

END OF APPENDIX "B"

DIVISION 2

SECTION 02921

SCREENED LOAM SOIL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the testing of screened loam soil, subgrade preparation, supplying and application of screened loam soil.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. As a guide to determine local weather predictions, use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

B. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, Current Edition, Northeastern Regional Publication No. 493 as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Obtain soil samples only during the following weather conditions:

1. There shall be no frost in the ground and the soil temperature shall be above 32 degrees F.
2. There shall be no form of precipitation falling or forecast to fall within the next two hours. Following a period of precipitation, resume operations only after the soil has drained.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Verify that the laboratory performing the laboratory testing of this Section is a certified testing laboratory such as the Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850 or an approved equal in either the State of New Jersey or New York, that it has experience in soil testing for soil properties important for plant and turf management and that is capable of performing a "Technical Topsoil Evaluation" as specified in 2.01 and as outlined on Appendix B of this Section.
2. Verify that the entity and its workers performing the Work of this Section are experienced in landscaping and have been engaged in work of a complexity similar to that required under this Section for a period of at least three years.

B. Test Requirements

1. Prior to delivery to the construction site, submit a representative sample of screened loam soil for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01. No modifications to testing parameters will be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, in accordance with 2.01 and Appendix "B" of this Section.
2. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.
3. Prior to delivery of screened loam soil to the construction site, submit to the Chief of Materials Engineering the following: 1.) The location and the source of the screened loam soil; 2.) A certified analysis of the loam soil that it meets this specification; 3.) A "Technical Topsoil Evaluation", including completing the "Soil Test Questionnaire and identifying that the soil shall be used for seeding for Tall Fescue; 4.) A two pound sample to the Chief of Materials Engineering and 5.) One sample for up to each 100 Cubic Yards of screened loam soil delivered to the construction site. In the event that the sample does not conform to the specified requirements, submit additional samples until the results do conform to this Section, all at no additional cost to the Authority.
4. Do not deliver screened loam soil to the construction site until the Chief of Materials Engineering has approved the submittal in writing.
5. After delivery of screened loam soil to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 1.04 B 3 and 2.01. Submit test results to the Chief of Materials Engineering for approval. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened loam soil from the construction site and replace it with material that does conform, all at no additional cost to the Authority.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver the screened loam soil to the construction site until the Chief of Materials Engineering has approved in writing the test results for the representative sample.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Screened Loam Soil

Fertile, friable, natural loam soil, free of subsoil, supplier-certified as having been obtained from an area that has never been treated with herbicide and conforming to the following:

1. Screened loam soil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass or any other undesirable material.

2. Screened loam soil shall contain a minimum of 5 percent organic matter and a maximum of 8 percent organic matter as determined by loss on ignition of moisture-free samples.

3. pH range shall be 5.0 to 7.0, inclusive.

4. The range of soluble salts shall be equal to or less than 500 micromhos per centimeter.

5. Screened loam soil shall be graded as follows:

PASSING	RETAINED ON	PERCENTAGE
1" screen		100%
1" screen	2 mm (No. 10) Sieve	Not more than 40%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

6. The portion of screened loam soil passing the 2 mm sieve, based on the mechanical analysis of the soil as determined by the Bouyoucous Hydrometer method, shall consist of the following, based on dry (air-dried only) weight of sample:

a. Sand 40% - 60%, inclusive;

b. Silt 30% - 40%, inclusive;

c. Clay 10% - 30%, inclusive.

2.02 ENVIRONMENTAL PARAMETERS

A. Verify that the concentration of environmental parameters in all soil mixes does not exceed the NYSDEC Technical and Administrative Guidance Memorandum #4046 Determination of Soil Cleanup Objectives and Cleanup Levels: Criteria for Recommended Soil Cleanup Objectives.

PART 3. EXECUTION

3.01 PREPARATION

A. Areas of Changed Grades

Verify that areas of changed grades shown on the Contract Drawing have a smooth, uniform surface.

1. Rototill subgrade to a minimum four-inch depth.

2. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials.

3. Rake and drag to remove high areas and fill depressions.

4. Limit preparation to areas, which will be planted promptly after preparation.

5. Remove all debris resulting from the soil preparation operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer.

6. Remove and transport off Authority property all debris materials resulting from the soil preparation operations in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".

B. Unaltered Areas

Prepare subgrade areas shown on the Contract Drawings as unaltered or undisturbed by excavation, grading or stripping operations as follows:

1. Remove existing vegetation and turf. Dispose of such materials away from Authority property.
2. Rototill to a depth of not less than six inches to produce a homogenous mixture of fine texture, free of clods, stones, roots and other extraneous materials.
3. Rake and drag to remove high areas and fill depressions.
4. Limit preparation to areas, which will be planted promptly after preparation.
5. Remove all debris resulting from the soil preparation operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer.
6. Remove and transport off Authority property all debris materials resulting from the soil preparation operations in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".

3.02 APPLICATION

A. Placing and spreading over prepared subgrade.

1. Place and spread screened loam soil over prepared subgrade in a uniform layer of such thickness that after compaction it shall be of the thickness and shall meet grades and elevations shown on the Contract Drawings.
2. After spreading, rake and dispose of stiff clods, hard lumps, rocks, roots, litter and other extraneous materials operations in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".
3. Fine grade to smooth, even surface.

END OF SECTION

SECTION 02921

SCREENED LOAM SOIL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Qualifications

1. Submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the Testing laboratory performing the Work of this Section.
2. Submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

B. Products

1. Submit in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS a complete "Product List", listing the product to be used under this Section.
2. Submit the location of the source of the screened loam soil and a two-pound representative sample of screened loam soil (as many as required) to the Chief of Materials Engineering in accordance with 1.04 B.

C. Test Reports

Submit laboratory analyses of screened loam soil and the results of the "Technical Topsoil Evaluation" to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 1.04 B and Appendix B.

1. Submit to the Engineer the test results for "Technical Topsoil Evaluation as specified in 1.04 B. 3 of this Section.
2. Submit to the Engineer the test results for the nutrient controls as recommended in the "Technical Topsoil Evaluation" as specified in this Section 1.04, B. 3, for "Seeding with Tall Fescue".

END OF APPENDIX "A"

SECTION 02921

SCREENED LOAM SOIL

APPENDIX "B"

The following is a sample testing form to be used by the Contractor:

Material: Screened Loam Soil

Specification: Section 02921 - Screened Loam Soil

Source of Sample:

Contract or P.O.#:

Type of Crop: Lawn

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Nutrients: Inorganic Nitrogen-Nitrate (ppm)			
Nutrients: Inorganic Nitrogen-Ammonium (ppm)			
Total Kjeldahl Nitrogen (%)			
Nutrients: P (pounds/acre)			
Nutrients: K (pounds/acre)			
Micro Nutrients: Zinc (ppm)			
Micro Nutrients: Copper (ppm)			
Micro Nutrients: Manganese (ppm)			
Micro Nutrients: Boron (ppm)			
Micro Nutrients: Iron (ppm)			
Organic Matter: (Loss of Ignition)	Min. 5% Max. 8%		
Soluble Salts: - Micromhos/Cm - PPM	Max. 500 Max. 300		
pH:	5.0 - 7.0		
Mechanical Analysis: Passing - 1"	100%		
Passing - 1" Retain 2 mm (#10)	Max. 40% The portion retained shall be no larger than 3/8" in size and shall be composed of homogeneous clods and/or stones		
Passing 2mm (#10) Retain Pan	Min. 60%		
Bouyoucous Hydrometer Test of			

Material:			
Passing 2 mm (#10) Percent - Sand	40%-60%		
Percent – Silt	30%-40%		
Percent – Clay	10%-30%		

END OF APPENDIX "B"

DIVISION 2

SECTION 02930

SEEDING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for endophyte seed, seeding, the application of flexible growth medium (FGM) and dust retardant at airports.

1.02 DEFINITIONS

A. The term "Blue Tag Certified" refers to the original certification tag, blue in color, which certifies that the seed was produced in Oregon, of the latest crop, bearing the lot number that matches the lot number on the Oregon State University Seed *Laboratory Report of Seed Analysis.*

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Use product-testing methods adopted and published by the Association of Official Analytical Chemists, 1111 19th Street Suite 210, Arlington, VA 22209.

B. As a guide to determine local weather predictions, use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

C. Seed and installation practices shall comply with Federal Aviation Administration (FAA) Advisory Circular 150/5200-33B, Hazardous Wildlife Attractants On Or Near Airports, August 28, 2007.

D. Pest control for turfgrass shall be in accordance with the "2009 Pest Management Guidelines for Commercial Turfgrass", published by Cornell University, Ithaca, NY. This publication is available from The Resource Center, Cornell University, Ithaca, NY 14853. Telephone (607) 255-9946.

E. Grass seed shall have attached thereto or in a conspicuous place on the exterior of the container a plainly printed label in the English language, in legible type specifying:

1. All endophyte seed lots shall be Blue Tag Certified, produced in Oregon, of the latest crop. The state of origin shall be Oregon, no exceptions.

2. Submit a copy of the Oregon State University Seed Laboratory Report of Seed Analysis bearing the lot number matching all the bags of seed delivered to the Work site.
3. Submit the name of Seed Company located in Oregon, along with the Blue Tag Certified seed variety, date of harvest and proof of storage in cold and dry conditions of the seed delivered to the Work site.
4. Submit the name and address of the person who labeled said seed, or who sells or offers the seed for sale to the Contractor if the seed being delivered to the Work site is not directly supplied to the Contractor from the originating seed company from Oregon.
5. Submit certification and the date seed was shipped, from 4 above, identifying that the seed delivered to the Work site shall have been shipped directly from Oregon and never stored anywhere else except the production facility in Oregon.
6. Submit the commonly accepted name of the kind or kind and variety, or both, of each agricultural seed component in excess of 5.0% of the whole and the percentage by weight of pure seed of each.
7. Percentage by weight of all weed seeds. Maximum weed seed content shall not exceed 1% by weight.
8. Lot number or other lot identification.
9. The percentage of germination, exclusive of hard seed; hard seed, if present, and the calendar month and year that the germination test was completed. If a single test date is used, it shall be that of the oldest tested component.
10. All delivered endophyte seed shall be fresh seed, having a proof of harvest date, and delivered to the Work site for immediate application. Seed delivered to the Work site for immediate application exceeding two months from the date it left storage in Oregon shall not be accepted. (See 1-5 above)
11. Any bag of seed without a blue tag and corresponding Oregon State University Seed Laboratory Report of Seed Analysis bearing the lot number matching all the bags of seed delivered to the Work site will be rejected by the Engineer and the Contractor shall immediately remove it from the Work site and replace with seed that complies with this Specification.
12. The percentage of endophyte level shall meet or exceed the level specified herein. Any test results as per 1.05 B. 5 of the bags of seed with a seed label indicating that the percentage level of endophyte is less than specified will be rejected by the Engineer and the Contractor shall immediately remove it from the Work site and replace it with seed that complies with this Specification.

F. Fertilizer application for turfgrass shall be as per all federal, state and local regulations.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the soil temperature at each planting area shall be above 32 degrees F.

2. There shall be no form of precipitation falling or forecast to fall within the next two hours. Following a period of precipitation, resume operations only after the soil has drained.

3. Apply chemicals only when wind velocity is below 5 mph, drift hazard is negligible, the air temperature is above 40 degrees F and below 70 degrees F.

4. Do not perform any product application if precipitation has fallen within two hours prior to the planned application time or is forecast during the next 12-hour period.

B. Seeding Calendar Limitations

Seed as per Appendix "B" of this Section.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity and its workers performing the Work of this Section are experienced in landscaping and have been engaged in work of a complexity similar to that required under this Section for a period of at least three years.

2. Verify that the entity performing pesticide applications has a valid license as a commercial applicator from the state in which the Work is being performed.

3. Verify that the entity performing fertilizer applications in New Jersey, has a valid certificate as a certified professional fertilizer applicator.

4. Verify that the entity performing the Work has a Brillion Turfmaker II Seeder to install the seed for this Work. Hydroseeding will not be permitted to be used.

5. Verify that the entity performing the Work has a Hydromulcher with a "mechanical agitator paddle" as manufactured by one of the following: Aqua Mulcher, Bowie, Finn, Kincaide or Turfmaker. A hydromulcher that uses "jet agitation" will not be permitted to be used.

B. General Requirements for Operations and Products

1. After delivery to the construction site, allow the Engineer, at his discretion, to take for analysis representative samples of any item listed in PART 2 - PRODUCTS.

2. Seed

a. Submit all the information specified in 1.03 E 1 -12 to the Engineer for review and approval prior to delivery to the Work site.

b. Do not furnish or plant the following turfgrasses under any circumstance:

Winter Wheat

Tall Fescue Grass with less than 90% Endophyte levels.

Tall Fescue Grass without Endophyte

Kentucky Blue Grass

Buffalo Grass

Bent Grass

Bermuda Grass

Fine Fescue Grass

Annual Rye Grass

Perennial Rye Grass with less than 90% Endophyte levels

Perennial Rye Grass without Endophyte

Native Grasses

3. Fertilizer

a. Do not apply fertilizer applications between December 1 and March 1 or any time when the ground is frozen.

b. Do not apply fertilizer during or just before a heavy rainfall or onto an impervious surface.

c. Apply only a fertilizer with a Water Insoluble Nitrogen (WIN) and other clearly marked sources of Slow Release Nitrogen equal to or greater than specified herein under PART 2 – PRODUCTS.

d. Apply fertilizer only at rate specified herein under PART 3 – EXECUTION or as recommended in the analysis issued by the New Jersey Agricultural Experiment Station at Rutgers, the State University, whichever provision recommends the least amounts of N, P & K.

e. Do not apply fertilizer containing nitrogen or phosphorous within 25 feet of any waterbody, except where a drop spreader, rotary spreader with a deflector, or targeted spray liquid is used, then the buffer may be reduced to 10 feet.

f. Prior to application of any fertilizer containing phosphorous, submit the results from the "Technical Topsoil Evaluation" from the Rutgers Soil Testing Laboratory as specified in Section 02920 – Soil Testing of the soil to be fertilized to determine the need for phosphorous. Apply only the amount of phosphorous recommended in the analysis issued by the New Jersey Agricultural Experiment Station at Rutgers, the State University.

g. Submit to the Engineer for his review and approval the fertilizer label including the chemical trade name, the full chemical analysis (N, P, K, WIN & other slow release % for N) and application rate.

4. Pesticide

a. Select specific pesticide(s)to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.

b. Prepare and maintain all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within 5 days when so requested.

c. Not less than forty-eight hours prior to a proposed spray operation, submit to the Engineer for his review and approval a tabulated list indicating the target to be treated, the chemical trade name and quantity of mix being prepared.

5. Testing for Endophytes

a. Submit the test result for "Seed Immunoblot Assay Testing". No later than two months prior to delivery of endophyte seed to the Work site, submit a sample of seed for testing in accordance with Appendix "B" and submit the results to the Engineer prior to delivery. Submit a minimum of one (1) pint of seed per every twenty (20) bags of seed delivered to the Work site.

b. Submit the test results for "Seed Grow-out Testing". No later than two months prior to delivery of endophyte seed to the Work site, submit a sample of seed for testing in accordance with Appendix "B" and submit the results to the Engineer prior to delivery. Submit a minimum of one hundred (100) seeds per every twenty (20) bags of seed delivered to the Work site.

c. Submit the test results for "Tiller Testing". No later than two months after on-site germination, submit tiller samples for testing in accordance with Appendix "B" and submit the results to the Engineer. Submit a minimum of fifty (50) tillers per every one (1) Acre of seeded area.

6. Soil Testing

a. Submit to the Engineer the "Technical Topsoil Evaluation" from the Rutgers Soil Testing Laboratory as specified in Section 02920 – Soil Testing. "Technical Topsoil Evaluation" lab request shall specify the crop to be grown as lawn.

b. Perform nutrient controls and pH adjustments as recommended in the "Technical Topsoil Evaluation" for establishing lawn. Nutrient and pH control adjustments shall be performed at no additional cost to the Authority.

7. Lawn Mower Equipment

a. Verify that the entity performing lawn mowing utilizes a Mulching Mower, capable of producing a fine mulch and produce no windrows. Furnish a list of lawn mowers to be used as well as the manufacturer catalog cuts describing how the mulching mower operates to produce a fine mulch and produce no windrows.

C. Reseeding

1. Replace unsatisfactory seeded areas for a period of six months from the date of rendition of the Certificate of Final Completion. Reseed all areas, at no additional cost to the Authority, that:

a.) are dead

b.) have weed and/or pest infestations

c.) have not provided 85% vegetative coverage as per Appendix "B"

d.) <90% endophyte viability proved by tiller testing performed on seed grow-outs and/or germinated seed at the construction site.

2. Perform replacement of unsatisfactory seeded areas with products and by operations that comply with all requirements of this Specification, and on such date(s) as ordered by the Engineer.

D. Application of Dust Retardant

1. Apply dust retardant on all unsatisfactory seeded areas and/or areas where soil is exposed, but cannot be seeded because the calendar seeding date limits have expired, all in accordance with 3.02 C.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

1.07 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Nutrient Controls

1. Fertilizer

Granular - 10-6-4, slow release fertilizer conforming to the following:

a. Commercial fertilizer 10-6-4, dust-free, homogenous, granular fertilizer with 50% nitrogen derived from ureaform (50% organic)

Guaranteed analysis shall be

10% Nitrogen,

3.0%-3.5% W.I.N. (water-insoluble nitrogen)

2.8 % Water Soluble Nitrogen* (*Contains slowly available Nitrogen from Methylene Urea)

4.2 % Ammoniacal Nitrogen

6% P_2O_5

4% K_2O

2.0 % Magnesium (Mg)

1.0 % Iron (Fe)

2. Soil pH adjustment

a. Granulated dolomitic limestone conforming to the following:

1). Total carbonates not less than 86% of 48.2% calcium oxide equivalent. For purposes of calculation, total carbonates shall be considered as calcium oxide. Magnesium oxide content shall be between 15 – 22%.

2). A dust-free, homogenous, granular material.

b. Soil pH adjustment - Elemental Sulfur

Guaranteed analysis shall be

0% Nitrogen

0% Phosphorus

0% Potassium

90% Sulfur

B. Turf Seed

1. Turf seed shall be the latest crop, clean, pure and free of noxious weed seed, of the variety and mix in accordance with Appendix "B" and to 1.03 E. 1- 12 and 1.05 B. 5.

2. Turf seed shall have a demonstrated cultivar performance, which includes Lateral Spread Technology (LS), high levels of rhizome expression, high density, insect resistance, greater than 90% viable endophyte and superior stress tolerance.

C. Dust-Retardant

1. "Coherex" as manufactured by Golden Bear Division of the Witco Corporation, Chandler, AZ 85244

2. "Soil-Sement" as manufactured by Midwest Industrial Supply, Inc., Canton, OH 44711

3. "Soil Seal Concentrate" as manufactured by Soil Seal Corporation, Los Angeles, CA 90017

4. Or approved equal.

D. Flexible Growth Medium

1. "Flexterra FGM" as manufactured by Profile Products, LLC. Buffalo Grove, IL 60089.

Or approved equal conforming to the following:

Clean, uniform, nontoxic, and free of seeds, fungi, and other plant pathogens;

Heat-processed in such a manner as to contain no growth or germination inhibiting factors.

Interlocking crimped polyester fibers combined with wood fiber and crosslinked tackifier having the following physical properties:

Moisture Content	12% +-3
Wood Fiber	85% Max
Locking Fibers	5.0% +-1
Crosslinked Tackifier	10% +-1
Water Holding Capacity	1500% Min
Organic Material	95% Min
pH	4.8 +-2

2. Flexible Growth Medium is available from the following suppliers:
   a. Pinelands Nursery, 232 Island Avenue, Columbus, NJ 08022
   b. All Pro Horticulture, 55 Motor Avenue, Farmingdale, NY 11735
   c. ACF Environmental, 48 Old Grays Brook Rd., Brookfield, CT 06804
   d. AH Harris & Sons, 17 Commercial Drive, Albany, NY 12205
   e. Pennington Seed, 9327 US RTE 1, Laurel, MD 20723

E. "Futerra F4NETLESS" as manufactured by Profile Products, LLC, Buffalo Grove, IL 60089 or approved equal conforming to the following:

Thickness	0.2 inches
Wood Fiber	85%
Locking Fibers	5.0%
Tensile Strength	4.3 lbs/ft
Water Holding Capacity	395%

Futerra F4NETLESS is available from the following suppliers:

a. Pinelands Nursery, 232 Island Avenue, Columbus, NJ 08022
b. All Pro Horticulture, 55 Motor Avenue, Farmingdale, NY 11735
c. ACF Environmental, 48 Old Grays Brook Rd., Brookfield, CT 06804
d. AH Harris & Sons, 17 Commercial Drive, Albany, NY 12205
e. Pennington Seed, 9327 US RTE 1, Laurel, MD 20723

F. Biodegradable Staple

1. Biodegradable staples shall be Round Top Bio-Pin, Turftacs, E-Staple, GreenStake, Futerra Stake or an approved equal.

2. Staples shall be biodegradable, able to biodegrade within 8-24 months and have sufficient strength and length to securely hold the erosion control mat.

G. Weed Control/Glyphosate

1. "Round-up Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

41% - Glyphosate N - (phosphonomethyl) glycine

59% - Inert Ingredients

H. Hydrogel

1. "Viterra Gelsclape" as manufactured by Amereq, Inc., New City, NY 10956.
2. "Super Sorb C" as manufactured by Aquatrols, Paulsboro, NJ 08066.
3. "Soil Moist" as manufactured by JRM Chemical, Inc., Cleveland, OH 44128.
4. "Horta-Sorb as manufactured by Horticultural Alliance, Inc., Sarasota, FL 34243.
5. Or approved equal.

PART 3. EXECUTION

3.01 PREPARATION

A. Areas of Changed Grades

Verify that areas of changed grades, which are to be seeded as shown on the Contract Drawings, are in conformance with the grading plans and have a smooth, uniform surface. Rototill subgrade to a minimum six (6) inch depth. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials. Limit preparation to areas, which will be seeded promptly after preparation.

Subgrade shall be defined as either existing in-place soil or clean fill placed after removing unsuitable existing soil or existing pavement and base aggregate.

B. Unaltered Areas

Where seeding is to be performed within areas that have not been altered or disturbed by excavation, grading or stripping operations, as shown on the Contract Drawings, prepare subgrade as follows:

1. Remove existing vegetation by applying "Roundup Pro" as per manufacturer's instructions, at least ten days prior to seeding. Dispose of such materials away from Authority property.

2. Rototill to a depth of not less than six inches to produce a homogenous mixture of fine texture, free of clods, stones, roots and other extraneous materials. Dispose of such materials away from Authority property.

3. Rake and drag soil surface to remove high areas and fill depressions.

4. Limit preparation to areas, which will be seeded promptly after preparation.

C. Sustainable Measures

Remove all debris resulting from the soil preparation operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer. Remove and transport off Authority property all debris materials resulting from the soil preparation operation in accordance with Division 1 clause entitled "Recycling of Construction Debris Materials".

D. Formulation, Application and Equipment

1. Use the manufacturers recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products away from Authority property.

E. Erosion Control and Sedimentation Measures

Apply erosion and sediment control measures at all times as required by this Contract and the governing regulatory agencies.

3.02 INSTALLATION

A. Seeding Operations

1. Apply two (2) inches of compost as per Section 02960 to all areas prepared to receive seed.

2. Apply 10 pounds of "Soil pH adjustment" per 1000 square feet to all areas to be seeded. Rototill "soil pH adjustment" to six (6) inch depth prior to seeding.

3. Apply 10-6-4 50% organic fertilizer, uniformly by machine at the rate of 1 pound of Nitrogen per 1000 square feet. Work lightly into the top six inches of soil.

3. Apply hydrogels and incorporate into the top six inches of soil at a rate of one (1) pound per 1,000 SF or as directed by the manufacturer.

4. Sow grass seed at the rate provided in Appendix B "Permanent Seeding" of this Section and cover in such manner that a uniform stand would result.

5. Seed the area uniformly in two passes using a Brillion Turfmaker II Seeder and in uniform rows that cross each other at an angle of 30 degrees. Apply seed at designated seeding rates for both passes as per Appendix B "Permanent Seeding".

6. For areas too small for the use of a Brillion Turfmaker II Seeder, apply seed at the designated seeding rates per 1000 square feet with a broadcast spreader.

7. Hydroseeding will not be permitted.

B. Mulching Seeded Areas

1. Strictly comply with manufacturer's installation instructions and recommendations. Use approved mechanically agitated, hydraulic mulching machines with a fan-type nozzle (50-degree tip).

   a. Fill tank to middle of agitator or tank about 1/3 full of water. Turn on pump to wet or purge lines. Begin agitating. Keep adding water slowly while adding the FGM at a steady rate.

   b. Mix at a rate of 50 lbs of FGM per 125 gallons of water. Verify with the equipment manufacturer the optimum mixing rates for the FGM.

   c. All FGM should be added once the tank is approximately ¾ full.

   d. Thoroughly agitate and mix slurry for at least 10 minutes after adding the last of the FGM to fully activate all the bonding additives and to attain proper viscosity.

   e. Turn off recirculation valve to minimize potential for air entrainment within the slurry.

2. Apply FGM uniformly in successive layers, from two or more directions, to accomplish 100% coverage of the soil surface at following rates:

   a.) Minimum application shall be 3,000 lbs/acre for slopes <3:1.

   b.) Minimum application shall be 3,500 lbs/acre for slopes >3:1.

3. Do not over-spray the hydromulch onto runways, taxiways, roadway, sidewalks, signs, fences, gravel swales or any structure or surface feature. Any over-spray found anywhere except where seed is required, shall be thoroughly cleaned and repaired, all at no additional cost to the Authority.

4. For areas too small for hydromulching with Flexible Growth Medium (FGM), install a netless flexible growth medium blanket such as the Futerra F4NETLESS blanket as per manufacturer's instructions. Use only biodegradable staples to secure Futerra F4NETLESS blanket to the soil surface.

C. Application of Dust Retardant

1. Apply dust retardant on all completed areas that have not been seeded and/or where seed germination is less that 50% after 3 weeks from date seed was sown and when the calendar seeding date limits (See Appendix "B") have expired and seeding can no longer be performed or as approved by the Engineer.

2. Apply dust retardant with an approved pressurized sprayer with a rating of 40-60 PSI.

3. Do not apply dust retardant if precipitation is forecast within 24-hours after application.

4. Apply dust retardant as many times as necessary to control stormwater and wind erosion, all at no additional cost to the Authority.

D. Care of Seeded Areas

As per Appendix "B" of this Section, provide "Full" Care conforming to the following:

1. Full Care

Upon completion of seeding operations, maintain seeded area(s) in accordance with Appendix "B" for Permanent Seeding of this Section.

END OF SECTION

SECTION 02930

SEEDING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of 'Inspections and Rejections' of Division 1 - General Provisions.

A. Qualifications

1. Submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.05 A. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.
2. Submit evidence of a valid pesticide applicator's license.
3. Submit evidence of a valid professional fertilizer applicator certificate.
4. Submit a list of equipment owned and to be used in this Contract in accordance with 1.05 A and B of this Section.
5. Submit a list of contracts or similar scope including contracts using similar construction methods, products and equipment. Provide Client Name, date of completion, number of acres seeded, Construction Cost, Contact Name and Phone Number.

B Products

1. Submit in accordance with the requirements of "Inspections and Rejections" of Division 1 -GENERAL PROVISIONS, a complete "Product List", listing all products to be used under this Section.
2. Submit for approval to the Engineer the seed requirements in accordance with 1.03 E, 1 – 12.
3. Submit for approval by the Engineer, the fertilizer requirements in accordance with 1.05 B. 3. f & g.
3. Submit for approval by the Engineer, that the entity performing the seeding has a Brillion Turfmaker II Seeder and a hydromulcher in accordance with 1.05 A. 4-5 and verify that it will used for this Contract.
4. Submit for approval by the Engineer, that the entity performing the lawn mowing has a Mulching Mower, in accordance with 1.05 B. 7 and to verify that it will be used for this Contract.

5. Submit certification from the manufacturer of Flexible Growth Medium that the installation meets or exceeds the required product preparation and application rates.

6. Submit the total number of bags of seed, applied at the minimum rate of 10 pounds per 1000 SF furnished and installed at the construction site in accordance with the amount of square feet of area prepared by the Contractor for seed.

7. Submit the total number of bags of FGM, applied at the minimum rate of 3000 lbs or 3500lbs per Acre furnished and installed at the construction site in accordance with the amount of square feet of area prepared by the Contractor for seed.

C. Submit to the Engineer one copy of U.S. Department of Labor Material Safety Data Sheets (MSDS) and product labels for all hazardous chemicals utilized during the Work of this Section.

D. Testing

1. Submit to the Engineer the Oregon State University Seed Laboratory Report of Seed Analysis bearing the Lot number matching all the bags of seed delivered to the Work Site.

2. Submit to the Engineer the test results for Endophyte level analysis as specified in 1.05 B. 5 of this Section.

3. Submit to the Engineer the test results for "Technical Topsoil Evaluation" as specified in Section 02920 and 1.05 B. 6. of this Section.

4. Submit to the Engineer the recommendations for the nutrient and pH controls in the "Technical Topsoil Evaluation" as specified in Section 02920 " Crop – Lawn".

END OF APPENDIX "A"

APPENDIX "B"

SECTION 02930

SEEDING

A. SEED MIX

Permanent Seeding

1. Seed Mixture shall have originated in Oregon and be as distributed by F M Brown Seed, Sinking Spring, PA 19608 (800) 345-3344, Lesco, Inc., Mountainside, NJ 07092 (908) 317-0509, Jonathan Green, Farmingdale, NJ, (732) 938-7007, All Pro Horticulture, Inc. ,721 Main Street, Farmingdale, NY 11735, (631) 789-6680 or approved equal and as follows:

Kind of Seed	% Mix:	% Min. Purity:	% Min. Germ:	% Min. Endophyte Infection:
Firecracker LS or Spider LS Tall Fescue	100	99	95	>90

2. Seeding rate shall be 10 pounds per 1000 square feet.
3. Seeding shall be performed only during the following periods:

   April 1 - May 31 (latest crop, subject to proper storage and testing results)

   August 16 - October 15 (latest crop, fresh seed, subject to proper storage and testing results)

4. Provide full care upon completion of seeding until issuance of Certificate of Final Completion. Full care shall include irrigation when bi-weekly rainfall does not exceed one (1) inch of rainfall per week at the construction site and a weed-free installation at all times, at no additional cost to the Authority.
5. Successful seeding shall be defined by the following:
   a. 85% survival of the specified turfgrass at the end of the Full care period as determined solely by the Engineer.
   b. Endophyte test results for tillers that meet the minimum % endophyte viability levels as specified on the "blue tag certified" label and matching Oregon State University Seed Laboratory Report Seed Analysis when submitted to the Engineer.

B. SEED MIX

Temporary Seeding for Soil Erosion and Sedimentation Control

1. Seed Mix shall be as distributed by F M Brown Seed, Sinking Spring, PA 19608 (800) 345-3344, Lesco, Inc., Mountainside, NJ 07092 (908) 317-0509, Jonathan Green, Farmingdale, NJ, (732) 938-7007, All Pro Horticulture, Inc, 721 Main St., Farmingdale, NY 11735 (631) 789-6680 or approved equal and as follows:

Kind of Seed	% Mix:	% Min. Purity:	% Min. Germ:	% Min. Endophyte Infection:
Assure, Legacy II or Wilmington Perennial Ryegrass	100	97	90	>90

2. Seeding rate shall be 8 pounds per 1000 square feet.
3. Seeding shall be performed:

   April 1 - October 15 (latest crop, fresh seed, subject to proper storage and testing results)

4. Provide full care upon completion of seeding. Full care shall include irrigation when weekly rainfall does not exceed one (1) inch of rainfall per week at the construction site.
5. Successful seeding shall be defined by the following:
   a. 85% survival of the specified turfgrass at the end of the Full care period as determined solely by the Engineer.
   b. Endophyte test results for tillers that meet the minimum % endophyte viability levels as specified on the "blue tag certified" label and matching Oregon State University Seed Laboratory Report Seed Analysis when submitted to the Engineer.

TESTING LABS/CONTACTS

1.) Oregon State University Seed Laboratory
3291 SW Campus Way
Corvallis, OR 97331-3801
Contact: Dr. Adriel Garay, Lab Manager
e-mail: adriel.garay@oregonstate.edu
Website: www.seedlab.oscs.oregonstate.edu
Tele: (541)-737-4464
Fax: (541)-737-2126
Endophyte Tests offered:

- Seed Testing: Immunoblot assay*
  Lab requires one-pint seed sample
- Seed Grow-out/Plant Tissue Endophyte Analysis*
- Plant Tissue: Grass Tillers Endophyte Analysis*

2.) Plant Diagnostic Lab
New Jersey Agricultural Experiment Station
Rutgers University
P.O. Box 550
Milltown, NJ 08850-0550
Contact: Richard Buckley
Tele: (732)-932-9140
Website: www.njaes.rutgers.edu/services
Endophyte Tests offered:

- Seed Testing: Endophyte Screening*
  Lab requires one pint of seed for testing.
- Plant Tissue: Grass Tiller Endophyte Analysis Test *
  Lab requires minimum of 50 tillers for tissue testing.

* Verify Fees/Sampling Procedures with Lab

END OF APPENDIX "B"

DIVISION 2

SECTION 02940

TREES, SHRUBS AND GROUND COVER (NEW YORK)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for furnishing, delivering and installing trees, shrubs and ground cover (hereinafter sometimes referred to as "plants").

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

B. To determine caliper, size, height, width and root spread of plants, use the "American Standard for Stock" (ANSI) ANSI Z 60.1-2004, published by the American Nursery & Landscape Association, 1000 Vermont Ave., NW, Suite 300, Washington, D.C. 20005.

C. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Rd., Suite 101, Londonerry, NH 03053.

D. As a guide to determine local weather predictions use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

E. Mulch shall conform to current standards established by Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 20111-4245.

G. Pest control for plants shall be in accordance with the "2006 Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs", published by Cornell University, Ithaca, NY. This publication is available from The Resource Center, Cornell University, Ithaca, NY 14853. Telephone (607)-255-9946.

H. All materials, activities and procedures shall be in accordance with the Federal Aviation Administration (FAA) – Advisory Circular No. 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports", August 28, 2007.

I. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, Current Edition, Northeastern Regional Publication No. 493 as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the soil and backfill materials temperature at each planting area shall be above 32 degrees Farenheit.

2. Perform planting and soil related operations only when no form of precipitation is falling or forecast to fall within the next 2 hours. Following a period of precipitation, resume operations only after the soil has drained.

B. Planting Calendar Limitations

Planting shall be performed only during the following periods:

Deciduous Plants:	March 1 - May 1 and October 15 - December 1
Evergreen Plants:	April 1 - May 15 and September 1 - October 15
Perennials	April 1 – July 1

1.04 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity and its workers performing the Work of this Section are experienced in landscaping and have been engaged in work of a complexity similar to that required under this Section for a period of at least five years.

2. Verify that the entity performing pesticide applications is certified in accordance with 6 NYCRR Part 326.2 Restricted Pesticides, under New York State Department of Environmental Conservation (NYSDEC) Division of Solid and Hazardous Materials.

3. Verify that the entity performing pruning, planting, inspections and maintenance of this Section is a current member of the International Society of Arboriculture (ISA) and State Chapter where it is located.

4. Verify that the ISA Certified Arborist possesses a minimum of the following:

   a. Associate's Degree in Horticulture from a recognized college.

   b. A total of five (5) years of work experience.

   c. A current member of the International Society of Arboriculture and State Chapter where he resides.

   d. Qualified by the International Society of Arboriculture during the time this individual is working on this Contract.

e. Quality Assurance.

(1) Qualifications: Verify that the entity performing the Work of this Contract utilizes the services of an ISA Certified Arborist who acts as superintendent for the installation and all maintenance of plantings for this Contract and who shall be on site at all times including but not limited to: plant material deliveries, maintenance of plants at the site after delivery and prior to installation, verifying the trunk flare and the presence of girdling roots on all trees prior to planting, planting, staking, mulching, pest management and application of bio-stimulants to all plant materials. Transmit from the ISA Certified Arborist to the Engineer information of any discrepancies or non-compliance to the Contract Specifications and Drawings.

5. Verify that the laboratory performing the laboratory testing of this Section is a certified testing laboratory such as the Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850,or an approved equal in either the State of New Jersey or New York and shall have experience in soil testing for soil properties important for plant and turf management and shall perform all tests as specified in 2.01 A, 2.01 B and as outlined in Appendix B and Appendix C of this Section.

B. General Requirements for Operations and Products

1. Products listed in PART 2 – PRODUCTS shall be approved in writing by the Engineer prior to their delivery to the construction site.

2. After delivery to the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Immediately remove from the construction site products which fail to comply with these specifications and replace with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these Specifications.

3. Obtain, retain, and make available for on-site inspection at all times, U.S. Department of Labor Material Safety Data Sheets for all toxic substances and hazardous materials to be used in this Contract. Give one copy of said sheets to the Engineer for review and approval prior to introduction of material to the construction site.

4. All plant materials shall be grown in nurseries located within the following states: Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

5. All plant material shall be 'Nursery Grown.' Nursery Grown shall mean that the fields from which the plants are to be obtained are from active and working nurseries where the following horticultural practices have been aggressively performed:

a. IPM Program - Integrated Pest Management Program

b. Cultivation - Including weed suppression

c. Fertilization

d. Pruning

e. Irrigation

Any plant material from a field where the above horticultural practices have not been consistently practiced in the last twelve (12) months will be rejected.

6. Pesticide

a. Select to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.

b. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate at the construction site only in a work area designated by the Engineer.

c. Dispose of spills and surplus products in a legal manner.

d. Keep all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within 5 days when so requested.

e. Not less than forty-eight hours prior to a proposed spray operation, submit to the Engineer for his approval a tabulated list indicating the target to be treated, the chemical trade name and quantity of mix being prepared.

f. All pesticide/herbicide applications will be subject to inspections by the Engineer. The Engineer may at any time suspend and reschedule a pesticide/herbicide application when, in his determination, weather conditions are unfavorable, facility operations would be hampered or the Contractor's methods or materials fail to comply with these Specifications.

7. Asian Longhorned Beetle

a. Be able to identify and be aware of the possibility of encountering the Asian Longhorned Beetle. If beetles are observed or are suspected of being present, immediately notify the Engineer and contact : N.Y.S. Department of Agriculture and Markets Division of Plant Industry, 4 Stewart Avenue, West Hampton Beach, NY 11878 (631) 288-1751 or (800) 554-4501 ext. 72087.

C. Specific Requirements for Operations and Products

1. Plants

a. Coordinate all arrangements and accompany the Engineer on all inspections of plants at the nursery. Provide a minimum of 48 hours prior notice to the Engineer. Do not dig or remove any plant prior to inspection by the Engineer.

b. All plants selected by the Engineer at the nursery will be sealed with Authority seals, or at the discretion of the Engineer, typical representative numbers of such plants may be sealed.

c. Deliver to the construction site plants which were sealed and whose seal numbers conform to the Engineer's nursery inspection records.

d. Unsealed plants that, in the sole opinion of the Engineer, are not equal in quality to the sealed samples will be rejected.

e. Each shipment shall be certified by Federal and State authorities to be free of insects and diseases. Arrange for inspection certificates to this effect that would be required by law, if the Authority were a private corporation, to accompany each shipment invoice and to be delivered to the Engineer.

f. All plants, sealed or unsealed, will be subject to tailgate inspection upon arrival at the construction site. All plants failing to meet the requirements of this Section will be rejected by the Engineer. Remove rejected plants from the construction site and replace at no additional cost to the Authority.

g. At the discretion of the Engineer, typical representative numbers of plants may be removed from their growing containers for inspection.

2. Drive/Walk Through Site Inspections

a. During the landscape installation period (prior to rendition of a Certificate of Final Completion), the Contractor's ISA Certified Arborist (NY) and the Contractor shall perform weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer, to address the following:

(1) Identify the status/progress of Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's schedule for completion of Work.

b. Within 48 hours of each site inspection, arrange for the Contractor's ISA Certified Arborist (NY) to submit a report stating the following:

(1) List of site inspection Attendees.

(2) Agenda and items discussed.

(3) Description of issues/problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

3. Screened Loam soil

a. Prior to delivery to the construction site, submit a representative sample of screened loam soil for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01 A. No substitution for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 A and Appendix B of this Section.

b. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

c. Prior to delivery of screened loam soil to the construction site, submit to the Chief of Materials Engineering the following:

1.) The location of the source of the screened loam soil and the name and address of the supplier.

2.) A certified analysis of the loam soil that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation" for the crop "Landscape Plants".

4.) One, two-pound sample for each 100 CY of Screened Loam soil required, to the Chief of Materials Engineering.

d. Do not deliver screened loam soil to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

e. After delivery of screened loam soil to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01.A. Submit test results to the Chief of Materials Engineering for approval for up to each 100 Cubic Yards of screened loam soil delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened loam soil from the construction site and replace it with material that does conform, at no cost to the Authority.

4. Planting Mix

a. Do not combine planting mix components until components have been approved in writing by the Chief of Materials Engineering.

b. After planting mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the planting mix to a certified independent laboratory to ensure conformance to requirements specified in 2.01 B. No substitutions for testing parameters will be permitted. Submit test results to the Chief of Materials Engineering, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 B and Appendix C of this Section.

c. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

d. Prior to delivery of planting mix to the construction site, submit to the Chief of Materials Engineering the following:

1.) The location of the source of the planting mix and the name and address of the supplier.

2.) A certified analysis of the planting mix that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation"for the crop

Botanical Name	Common Name
Gleditsia Triacanthos Inermis	Honeylocust
Larix Laricina	American Larch
Quercus Alba	White Oak
Quercus Palustris	Pin Oak
Quercus Rubra	Red Oak
Tilia Americana	American Linden
Picea Abies	Norway Spruce
Picea Glauca	White Spruce
Picea Pungens Glauca	Colorado Blue Spruce
Pinus Strobus	Eastern White Pine
Amelanchier x grandiflora Cumulus	Cumulus Serviceberry

Cercis canadensis "Forest Pansy"	Forest Pansy Redbud
Prunus Okame	Okame Cherry

4.) One, two pound sample for each 100 CY of planting mix required, to the Chief of Materials Engineering.

5.) A letter certifying that the source components and their suppliers, of the planting mix are all as approved by the Chief of Material Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.

e. Do not deliver planting mix to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

f. After delivery of planting mix to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 B. Submit test results to the Chief of Materials Engineering for approval for up to each 100 CY of planting mix delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered planting mix from the construction site and replace it with material that does conform, all at no cost to the Authority.

5. Compost

a. Prior to delivery of planting mix to the construction site, submit to the Chief of Materials Engineering the following:

1). The location of the source of compost and the name and address of the supplier.

2). A certified analysis of the compost that it meets the specification herein. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

3). A ¼ pound sample.

4). In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

D. Environmental Parameter

1. Verify that the concentration of environmental parameters in all screened loam soil and planting mixes, not exceed the NYSDEC Technical and Administrative Guidance Memorandum #4046 Determination of Soil Cleanup Objectives and Cleanup Levels: Criteria for Recommended Soil Cleanup Objectives.

E. Replacement

1. Replace unsatisfactory furnished and installed plants which, in the sole opinion of the Engineer, have died or have otherwise become unsatisfactory.

2. Replace unsatisfactory plants with products and by operations that comply with all requirements of these Specifications, and on such date(s) as ordered by the Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products in a legal manner.

D. Specific Requirements

1. Loam soil, Planting Mix and Compost.

Conform to requirements of 1.04 C.3, 1.04 C.4. and 1.04 C. 5.

2. Trees, Shrubs and Ground Cover

Conform to requirements of 1.04 C.1 and as follows:

a. Transport plants in covered trucks only. Plants transported on open trucks from the nursery will be rejected by the Engineer.

b. Do not stack plants on top of one another at any time during delivery and transport to the Work site or during storage prior to installation.

c. Carry plants by the ball or container and not by stems.

d. Do not drop plants.

e. Protect all delivered plants from drying out by providing shade and water. Do not allow plants to become dry or wilted.

f. After plants have been set on the ground, apply water as needed, and cover balls with plastic sheeting.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Screened Loam soil

Fertile, friable, natural loam soil, free of subsoil, taken from a depth of no more than 1 foot, or less if subsoil is encountered, supplier-certified as having been obtained from an area which has never been treated with herbicide and conforming to the following:

1. Screened loam soil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass and any other undesirable material.

2. Provide a soil nutrient analysis providing the percentage Nitrogen (N), Phosphorus (P) and Potassium (K) in pounds per Acre.

3. Provide soil micronutrient analysis providing the percentage of Zinc, Copper, Manganese, Boron and Iron, in parts per million.

4. Screened loam soil shall contain a minimum of 5 percent organic matter and maximum of 7 percent organic matter as determined by loss of ignition of moisture-free samples.

5. pH range shall be 5.0 to 7.0, inclusive.

6. The range of soluble salts shall be equal to or less than 500 micromhos per centimeter.

7. Screened loam soil shall be graded as follows:

Passing	Retained On	Percentage
1" screen		100%
1" screen	2mm (No.10) Sieve	Not more than 40%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

8. The portion of screened loam soil passing the 2mm sieve, based on the mechanical analysis of the soil as determined by the Buoyoucous Hydrometer method, shall consist of the following based on dry weight of sample:

   a. Sand 40% - 60%, inclusive

   b. Silt 30% - 40%, inclusive

   c. Clay 10% - 30%, inclusive

B. Planting Mix

Composed of screened loam soil, various soil amendments and nutrient control materials conforming to the following:

1. Planting mix shall contain a minimum of 7% and a maximum of 15% organic matter as determined by loss on ignition of moisture free samples, and the pH range of 5.0 to 7.0, inclusive, with 60% passing a 1" screen.

2. The range of soluble salts shall be equal to or less than 1250 micromhos per centimeter.

3. Each 5 cubic yards of planting mix shall contain:

   a. 3 3/4 cubic yards of screened loam soil;

   b. 1 1/4 cubic yards of compost

   c. 17 lbs. of Hydrogel

4. Planting mix shall be loose, friable and not frozen or saturated at the time of mixing.

C. Compost

1. Compost shall be derived from biosolids, free of viable weed seeds and contain material of a generally humus nature. The product shall not contain any materials toxic to plant growth or produce objectionable odors. Compost shall meet Environmental Protection Agency (EPA) Exceptional Quality Standards and all State Environmental Agency requirements. Variations in the following specified physical properties are not acceptable. Compost shall conform to the following:

Parameters	Range
pH	5.7 - 7.7
Moisture Content	35% - 55%
C:N Ratio	15-30:1
Organic Matter	40% - 50%
*Soluble Salts	<5.0
Saturated Paste Method	Mmhos/cm(ds/m)
Nitrogen	>1.5%
Phosphorus	<20%
Potassium	<0.5%

*See Appendix "D" for allowable compost application rates based upon soluble salts levels.

D. Weed Control

1. Pre-emergent Herbicide

   "Treflan 5G" as manufactured by Elanco Products Co., Indianapolis, IN 46285 or approved equal.

2. Post-emergent Herbicide/Glyphosate.

   "Roundup Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

E. Hydrogel

1. "Viterra Gelscape" as manufactured by Amereq, Inc., New City, NY 10956.
2. "Super Sorb" as manufactured by Aquatrols Corps of America, Inc., Cherry Hill, NJ 08003.
3. "Soil Moist" as manufactured by JRM Chemical Inc., Cleveland OH 44125
4. "AquaGel A, B, C, D" as manufactured by Profile Products, Buffalo Grove, IL 60089
5. Or approved equal.

F. Nursery Stock

1. Furnish trees, shrubs, ground cover and perennials in the quantity, species, and meeting the size, height and width requirements shown on the Contract Drawings.
2. Furnished plants shall conform to the following:

a. Measure plant size as it stands in its natural position.

b. Conform to tree caliper, shrub sizes, heights and widths as shown on Contract Drawings.

c. For container grown plants, if used, conform to the dimensions for height, width, number of canes and container size as shown on the Contract Drawings.

d. For B & B grown plants, if used, do not install or leave in the planting hole any "No Rot" treated burlap or twine. Remove the "No Rot" burlap and twine in it's entirety and dispose of in a legal manner away from PA property.

e. Plants furnished shall be an average of the minimum and maximum sizes shown on the Contract Drawings.

f. Do not use large plants cut back to sizes specified.

g. Plants shall be sound, healthy, vigorous growing specimens.

h. Plants shall exhibit uniform growth and a form characteristic of their species.

i. With respect to their canes, trunks, stems, and branches, shrubs shall:

(1) Have normal, well-developed canes and branches.

(2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sun-scald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, damage due to machinery operation, improper pruning and blasted buds.

j. Plants' foliage shall be free from chlorosis, yellowing, blemishes and damaged parts.

k. Plants shall have vigorous, fibrous root systems.

l. Container grown plants, if used, shall have been grown in the container long enough to develop new fibrous roots so that the root mass will retain its shape and hold together when removed from the container. Recently potted or root-bound plants shall not be accepted by the Engineer. Container-grown plants shall be free from girdling roots.

m. With respect to their trunks and branches, trees shall:

(1) Have normal, well-developed branches.

(2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sun-scald injuries, abrasions of the bark, girdled trunk or branches, head malformed from over crowding within Nursery fields, damage due to machinery operation, improper pruning and blasted buds.

(3) Have straight trunks with a sturdy central leader. Clump forms may have more than one straight leader. Lateral branches shall arise near right angles forming a U-shaped crotch. Trees with V-shaped crotches will be rejected by the Engineer.

(4) Have been properly pruned to ensure a strong, sturdy and symmetrically shaped canopy.

(5) Root flare exposed and no native soil or container soil found to be above the tree's or shrub's natural root flare at the trunk.

(6) Whenever, the root flare is not exposed, an airspade shall be employed to expose the natural root flare. The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

n. With respect to their roots, trees shall:

(1) Be free from girdling roots.

(2) If girdling roots are present, have the ISA Certified Arborist (NY) remove them at no cost to the Authority.

(3) If it is determined that the girdling root cannot be satisfactorily removed by the ISA Certified Arborist (NY), then remove the affected tree immediately and replace it with a tree that meets this specification, at no additional cost to the Authority.

(4) Bareroot plants will be prohibited.

3. Instructions for digging and balling plants are as follows:

a. Dig immediately before moving.

b. Dig to retain as many fibrous roots as possible.

c. Do not use loose, broken or manufactured balls.

d. Wrap and tie balled and burlapped plants with untreated burlap and sisal or jute twine. Do not ball and tie with treated (or "no rot") material.

e. Trees - Trunk Flare

(1) Trees shall have all excess soil removed from the top of the true root ball and full exposure of trunk flare, prior to ball and burlap operations at the Nursery.

(2) The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

(3) Trees delivered to the construction site with 2" depth (or greater) of excess soil on top of the true root ball, girdling roots and unexposed trunk flare will be rejected by the Engineer.

G. Soil pH Adjustment

1. Soil pH adjustment

a. Elemental Sulfur

Guaranteed analysis shall be

0% Nitrogen

0% Phosphorus

0% Potassium

90% Sulfur

b. Granulated Dolomitic Limestone

As manufactured by Southdown, Inc., Lee, MA 01238, or approved equal conforming to the following:

(1) Total carbonates not less than 86% of 48.2% calcium oxide equivalent. For purposes of calculation, total carbonates shall be considered as calcium oxide. Magnesium oxide content shall be between 15-22%.

(2) A dust-free, homogenous, granular material.

H. Fertilizer/Bio-Stimulants (Trees)

1. Fertilizer

a. Fertilizer shall be 'Healthy Start 12-8-8 Macro Tabs', 21 gram tablets, as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:.

Essential Element Ingredient:	% Analysis by Weight:*
Nitrogen	12.0% (8% controlled release)
Phosphorus	8.0%
Potassium	8.0%
Calcium	2.0%
Sulfur	1.0%
Magnesium	0.2%
Iron	0.2%

*Organic forms derived from Ureaform (Nitroform), Methlene Ureas (Nutralene), Ammoniated Phospates, Bone Meal, Blood Meal, Kelp Meal, Feather Meal, Sulphate of Potash, Longbeinite, Humates, Whey Protein and Rice Bran.

Soil Conditioner Ingredients:	Derived From:
Humic Acid (Minimum 12% by weight)	Natural Humates
Natural Sugars, Dried Yeast & Other Carbohydrates	Processed Grain Byproducts
Amino Acids	Animal and Plant Proteins
Yucca Plant Extract (Wetting Agent)	Yucca schidigera
Sea Kelp (Biostimluant)	Ascophylum nodosum

Beneficial Bacteria:	Per 21 Gram Tablet:
Nitrogen-Fixing Bacteria Spores	2 million
Phosphorous-Solubilizing Bacteria Spores	2 million
Growth-Promoting Bacteria Spores	2 million

2. Bio-Stimulants

a. Bio-stimulants shall be 'Mycor-Tree Saver Transplant' as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:

Ingredients:	Analysis (per 3 ounce packet):
Live Spores of VA Endomycorrhizal Fungi	Minimum of 1000 Spores of Vesicular-Arbuscular (VA) Fungi. Includes: Entrephospora columbiana, Glomus etunicatum, Glomus clarum and Glomus sp.
Live Spores of an Ectomycorrhizal Fungus	Minimum of 60 million spores of Pisolithus tinctorius.
Terra-Sorb HB Water Absorbent Gel	Acrylamide copolymer gel
Dry Soluble Yucca Plant Extract	Yucca schidigera
Soluble Sea Kelp Extract	Ascophylum nodosum
Humic Acids	Leonardites Humates

I. Fertilizer/Bio-Stimulants (Shrubs, Ground Cover and Perennials)

a. Fertilizer/Bio-Stimulant shall be a granular, organic fertilizer and soil conditioner with beneficial mycorrhizal fungi and nitrogen-fixing/phosphorus solubilizing bacteria. Fertilizer/Bio-Stimulant shall be 'Mycor 4-7-4 + Micros Plant Saver', as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:

Beneficial Mycorrhizal Fungi Bacteria:	Analysis (per 4 ounces)
Live Spores of VA Endomycorrhizal Fungi	Minimum of 300 Spores of Vesicular-Arbuscular (VA) Fungi. Includes: Entrephospora columbiana, Glomus etunicatum, Glomus clarum and Glomus sp.
Live Spores of an Ectomycorrhizal Fungus	Minimum of 10 million spores of Pisolithus tinctorius.
Nitrogen-Fixing Bacteria	Approx. 50 million per pound
Phosphorus-Solubilizing Bacteria	Approx. 50 million per pound
Growth Promoting Bacteria	Approx. 50 million per pound

Soil Conditioner Ingredients:	Derived From:
Humic Acid (Minimum 15% by Weight)	Natural Humates
Complex Carbohydrates and Dried Yeast	Processed Grain Byproducts
Amino Acids	Animal and Plant Proteins
Yucca Plant Extract (Wetting Agent)	Yucca schidigera
Sea Kelp Extract (Biostimulant)	Ascophylum nodosum

Guaranteed Nutrient Analysis 4-7-4:

Nutrient:	% Analysis By Weight:
Nitrogen (N)	4.0%
Phosphate (P2O5)	7.0%
Potassium (K2O)	4.0%
Calcium (Ca)	6.0%
Sulfur (S)	2.4%
Magnesium (Mg)	3.0%
Iron (Fe)	3.0%
Manganese (Mn)	0.7%
Zinc (Zn)	0.4%

J. Pruning Alcohol

1. A commercial ethylalcohol or "Ethanol" 70-95%.

M. Tree Staples

1. Tree staples shall be uncoated, cold-rolled, plain carbon steel as manufactured by Tree Staple, Inc., 139 South St., New Providence, NJ 07974, (877) 873-3749, as per U.S. Patent No.'s 141, 903 & 6,065,243.
2. Staple sizes shall as shown on the Contract Drawings and identified as follows:

Stake Model	Planting Size	Number of Staples/Tree
TS24-8-8	1" – 2" caliper	Min. 2 per tree
TS36-10-10	2" – 4" caliper	Min. 2 per tree
TS42-12-12	4" – 6" caliper	2 – 3 per tree
TS48-12-12	6" – 8" caliper	2 – 3 per tree

3. Tree Staples are available from the following suppliers:
   a. NYP Corp., 805 East Grand St., Elizabeth, NJ 07201
   b. Northern Nurseries, 487 Elizabeth Ave., Somerset, NJ 08873

c. Northeastern Supply, 50 Notch Rd., West Paterson, NJ 07836

d. Or approved equal.

N. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

O. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:

a. Constructed of ultra-violet light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.

b. Each TreeGator bag shall have a 20 gallon water capacity and weigh 1 ½ pounds empty.

2. TreeGator portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that final grades have been established prior to start of planting operations.

B. Inspect trees, shrubs and ground cover for injury, wilting, pest infestation, location of the root flare in comparison to top of root ball or container, girdling roots and improper pruning. Do not plant until deficiencies are corrected, or plants are replaced.

3.02 PREPARATION

A. Areas of Changed Grades

Verify that areas of changed grades, which are to be landscaped as shown on the Contract Drawings, are in conformance with the grading plans and have a smooth, uniform surface. Rototill subgrade to a minimum six (6) inch depth. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials.

Subgrade shall be defined as either clean fill soil or in-place soil found after removing the required existing soil or existing pavement and existing base subgrade as shown on the drawings.

B. Areas to receive "Shrub and Perennial Mass" plantings [Screened Loam Soil (Section 02921) and Compost (Section 02960)].

1. Apply six (6) inches of screened loam soil and two (2) inches of compost to all areas to receive landscape plantings in two lifts of three (3) inches screened loam soil and one (1) inch of compost.

2. Rototill the first lift of three (3) inches screened loam soil and one (1) inch of compost into the existing subgrade in order to achieve an homegeneous mix.

3. Add the second lift of three (3) inches screened loam soil and one (1) inch of compost and rototill the screened loam soil and compost in order to achieve an homogeneous mix.

3.03 INSTALLATION

A. Excavation of Plant Pits

1. For balled and burlapped plants (B&B) and container grown plants, excavate soil from plant pits to conform to the following:

Size of Ball or Container	Diameter of Hole	Depth Below Bottom of Ball or Container
Less than 4 feet diameter	2 x diameter of ball or container	6 inches
4 to5 feet diameter	1-3/4 x diameter of ball or container	8 inches
Over 5 feet diameter	1-1/2 x diameter of ball or container	8 inches

2. Prior to planting, excavated plant pits shall be subject to Engineer's approval.

3. At no time shall excavated material be stockpiled on site. Remove excavated material immediately from the construction site and dispose of in a legal manner.

B. Trees: Trunk Flare and Girdling Root Verification

1. Verify and locate the top elevation of the true root ball and remove any excess soil depth to expose trunk flare at the base of the tree trunk prior to lifting and transporting tree into excavated plant pit.

2. Remove any excess soil located on top of the root ball, expose the trunk flare as shown on the Contract Drawings and remove girdling roots as directed by the Engineer and at no additional cost to the Authority. Arrange for all work to be provided by the Contractor's ISA Certified Arborist (NY) at no additional cost to the Authority.

3. The top elevation of the true root ball shall be even with or no more than 2" higher than adjacent finished grade elevations.

4. Do not plant trees until the trunk flare has been exposed, all girdling roots removed, and the top elevation of the true root ball has been established and approved by the Engineer.

5. Perform all work and verification in the presence of the Contractor's ISA Certified Arborist (NY) and the Engineer.

C. Planting Operations

Plant only in the presence of the Engineer, and as follows:

1. Planting B & B and Container Grown Plants

a. Handle plants so that the root ball will not be loosened. Do not handle trees by their trunks and shrubs and ground cover by their stems when transplanting or shifting plants.

b. Set plants plumb.

c. Set tree so that top of root ball is level with the finished grade after settlement.

d. For container grown plants, carefully remove the container and cut edge-roots with knife on three sides, taking care not to damage the roots. Carefully loosen the roots by hand from the container potting media and gently spread the roots out into the planting mix backfill.

e. For B & B plants, after the planting mix has been thoroughly firmed under and around the ball, cut and remove burlap away from the collar and from the upper half of the ball and adjust the remaining burlap to prevent the formation of air pockets. Remove wire baskets from root balls entirely. Where directed by the Engineer, remove burlap entirely. Prune and remove girdling roots and perform all necessary tree pruning under the supervision of the Contractor's ISA Certified Arborist (NY) and the Engineer.

f. Avoid bruising or breaking roots when tamping soil.

g. Firm planting mix at 6- to 8-inch intervals and thoroughly settle it with water.

i. After planting, thoroughly saturate the soil around each tree with water.

2. Fertilizer/Bio-Stimulants

a. Fertilizer/Bio-Stimulants (Trees)

(1) Provide one (1) application of each Fertilizer/Bio-Stimulant to all trees installed under this Contract, during the initial installation of each tree, as supervised by the Contractor's ISA Certified Arborist (NY) and the Engineer.

(2) Apply twenty-one (21) gram fertilizer tablets at time of planting operations as per the manufacturer's directions and as follows:

Tree Root Ball Size:	Quantity of 21 Gram Fertilizer Tablets Req:
18"-28" Diameter	5 Tablets
30"-38" Diameter	6 Tablets
42"-48" Diameter	8 Tablets
54"-70" Diameter	10-12 Tablets

(3) Incorporate bio-Stimulants into the top 8" of planting mix around the root ball after the tree has been planted as per the manufacturer's directions and as follows:

Tree Root Ball Size:	Quantity of 3 Ounce Packets Required:
18"-28" Diameter	2 Packets
30"-38" Diameter	3 Packets
42"-48" Diameter	4 Packets
54"- 70" Diameter	5 Packets

70" Diameter	6 Packets
80" Diameter	7 Packets

(4) Bio-Stimulant Application Method:

(a.) Place the tree into planting pit and backfill with planting mix to within 3"-4" from top of root ball.

(b.) Evenly spread the contents of bio-stimulant packets into a "doughnut shaped" ring up to 8" in width around the outside edge of the root ball.

(c.) Backfill remaining 3"-4" with planting mix.

(d.) Thoroughly mix the top 3"-4" planting mix by hand, around the edge of the root ball up to 8" wide to a depth of approximately 8".

(e.) Pack firmly and water to soil saturation.

b. Fertilizer/Bio-Stimulants (Shrubs,Ground Cover and Perennials)

(1) Provide one (1) application of Fertilizer/Bio-Stimulants to all shrubs and ground cover installed under this Contract, during the initial planting installation, as supervised by the Contractor's ISA Certified Arborist (NY) and the Engineer.

(2) Incorporate Fertilizer/Bio-Stimulants into the top 6"-8" of planting mix of plant pits of each shrub and ground cover during the initial planting installation, as per the manufacturer's directions and as follows:

Plant Container/Root Ball Size:	Application Rates (Per 4 Ounce Scoop):
1 Gallon Container	One Scoop (4 Ounces)
2 Gallon Container	One Scoop (4 Ounces)
3 Gallon Container / 10" Root Ball	Two Scoops (8 Ounces)
5 Gallon Container/ 12"-14" Root Ball	Two Scoops (8 Ounces)

D. Tree Stapling

1. Install as shown on the Contract Drawings.

2. Submit written verification from the manufacturer that Tree Staples have been installed according the manufacturer's instructions.

E. Edging of Planting Areas

1. Establish a neat edge where planting areas meet turf areas as shown on the Contract Drawings.

2. Edge with a spade or edging tool immediately after planting and seeding is completed.

F. Mulching

1. Cultivate and rake planted areas and leave in an orderly condition.
2. On level ground or slight slopes, leave a shallow basin a little larger than the diameter of the plant pit as shown on the Contract Drawings.
3. Place a minimum of 2 inches of shredded hardwood bark mulch in the plant basin. Depth of mulch shall not exceed 3 inches.
4. Wherever shrubs, ground covers and perennials have been planted in a continuous bed, apply a minimum of 2 inches of shredded hardwood bark mulch over the entire planting bed. Depth of mulch shall not exceed 3 inches. Exposed bare soil will not be acceptable.
5. Maintain a minimum radius of 4 inches between the tree or shrub trunk flare and the start of the mulch.
6. Mulch volcanoes are prohibited. Whenever mulch is inappropriately applied, remove the inappropriately installed mulch from the construction site and replace it in conformance with the original Contract Drawings. All at no cost to the Authority.

G. Irrigation

1. Commence irrigation immediately after planting using TreeGator bags and maintain as required until issuance of Certificate of Final Completion.

2. Thoroughly water all plant materials at time of installation. Thereafter adhere to the following minimum watering schedule:

   a. Week one following planting: Fill TreeGator bags daily.
   b. Week two following planting: Fill TreeGator bags three days per week
   c. Week three through week Twelve: Fill TreeGator bags two days per week
   d. Week Twelve through issuance of Certificate of Final Completion: Fill TreeGator bags one day per week.

3. Increase or decrease frequency of watering as determined by monitoring the local weather observations and predictions provided by the National and Local Forecast, Hurricane, Radar and Report as published by the Weather Channel (JFK – Jamaica, NY – 11430).

H. Plant Maintenance

1. Maintain plantings as per Section 02971 – Maintenance of Permanent Plantings & Hardscape (NY) and by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep shrubs free of insects and disease.

2. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

3. Apply treatments as required to keep plant materials, planted areas and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

I. Arborist's Site Inspections/Reports

1. During the installation period (prior to rendition of a Certificate of Final Completion), make available the Contractor's ISA Certified Arborist (NY) who, accompanied by the Contractor and the Engineer, shall perform weekly drive and walk through site inspections of the construction site, identifying the status of the installation work, issues or problems requiring immediate action by the Contractor and items affecting the Contractor's work schedule.

2. Within 48 hours of each site inspection, transmit from the Contractor's ISA Certified Arborist (NY) a 'Site Inspection Report', to include but not be limited to: list of inspection attendees, item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates by which the Contractor will implement said Work.

END OF SECTION

SECTION 02940
TREES, SHRUBS AND GROUND COVER
(NEW YORK)

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of 'Inspections and Rejections' of Division 1 - General Provisions.

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the Testing laboratory performing the work of this Section.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of the Entity's membership to the International Society of Arboriculture and State Chapter where it is located ion accordance with 1.04.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications in writing for approval by the Engineer of the ISA Certified Arborist performing the Work in accordance with 1.04 A.4. Include the name of the arborist, resume and a description and contract amounts for work performed in the last two years.

4. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone number, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

5. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of a valid pesticide applicators license, in the state in which Work is to be performed.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS:

   a. A complete "Products List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.

   b. Material Data Safety Sheets for all toxic or hazardous materials to be used under this Section.

   c. A complete "Plant List", listing all greenhouse and nursery sources for all trees, shrubs, ground cover and seasonal display (perennial) plantings; including written verification according to 1.04B4, 1.04 B5 and 1.04 C1.

2. Submit the location of the source and the name and address of the supplierof the screened loam soil, planting mix and compost and a representative samples (as many as required) to the Chief of Materials Engineering in accordance with 1.04 C.3., 1.04C.4 and 1.04 C5.

C. Test Reports

Submit laboratory analyses of screened loam soil,planting mix and compost to the Chief of Materials Engineering, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 1.04 C 3, 1.04 C 4, 1.04 C5, Appendix B and Appendix C. After initial approval, thereafter, submit one laboratory analysis for up to each 100 CY of planting mix delivered to the site.

D. Certifications

1. Submit plant inspection certificates, in accordance with requirements of 1.04 C.1.e.
2. Submit to the Chief of Materials Engineering certification required by 1.04 D.
3. Submit certification from the Tree Staple manufacturer.
4. Submit verification that all screened loam soil do not exceed the NYSDEC Technical and Administrative Guidance Memorandum # 4046 Determination of Soil Cleanup Objectives and Cleanup Levels: Criteria for Recommended Soil Cleanup Objectives.
5. A letter certifying that the source components and their suppliers, of the planting mix are all as approved by the Chief of Material Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.
6. Submit verification that B& B and container grown plants are in accordance with 2.01 F and 3.02 B.
7. Submit verification that final grades have been established prior to start of planting operations.

E. Arborist's Site Inspection Reports

1. Within 48 hours of each weekly site inspection, transmit from the Contractor's ISA Certified Arborist (NY) a 'Site Inspection Report' in accordance with the requirements of 1.04.C.2.

END OF APPENDIX "A"

SECTION 02940

TREES, SHRUBS AND GROUND COVER (NEW YORK)

APPENDIX "B"

Material: Screened Loam Soil

Specification: Section 02921 – Screened Loam soil

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 5% Max. 7%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 500 Max. 300		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent – Silt	30% - 40%		
Percent - Clay	10% - 30%		

END OF APPENDIX "B"

SECTION 02940

TREES, SHRUBS AND GROUND COVER (NEW YORK)

APPENDIX "C"

Material: Planting Mix

Specification: Sections 02940 & 02971

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 7% Max. 15%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 1250 Max. 750		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 30%		

END OF APPENDIX "C"

SECTION 02940

TREES, SHRUBS AND GROUNDCOVER (NY)

COMPOST – SOLUBLE SALTS LEVELS

APPENDIX "D"

Use the following table* to determine the maximum allowable ECe(dS/m of saturation extract) of compost at the desired application rate:

Desired Use Rate		Salinity (ECe) of On-Site Soil		
Cubic Yards Amendment per 1000 Sq. Ft. for incorporation to 6" depth	Volume Percentage of Amendment	3 dS/m	2 dS/m	1 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9. 5	14
4	22	3. 5	7	10. 5
5	27	3	5. 5	8. 5
6	32	2. 5	4. 5	7

Example: If Specification calls for 6 cubic yards compost per 1000/sq. ft. to be incorporated into the top 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding an ECe of 4 in the final blend, compost ECe should be less than 4.5 dS/m.

* This table is as per "Compost – A Guide for Evaluating and Using Compost Materials as Soil Amendments", by William Darlington, Soil & Plant Laboratory, Inc. as published by the University of California Extension Service, Orange County Office.

END OF APPENDIX "D"

DIVISION 2

SECTION 02954

TREES, SHRUBS AND GROUND COVER (NEW JERSEY)

PART 1. GENERAL.

1.01 SUMMARY

This Section specifies requirements for furnishing, delivering and installing trees, shrubs and ground cover (hereinafter sometimes referred to as "plants").

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

B. To determine caliper, size, height, width and root spread of plants, use the "American Standard for Stock" (ANSI) ANSI Z 60.1-2004, published by the American Nursery & Landscape Association, 1000 Vermont Ave., NW, Suite 300, Washington, D.C. 20005.

C. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Rd., Suite 101, Londonerry, NH 03053.

D. As a guide to determine local weather predictions use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

E. Mulch shall conform to current standards established by Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 20111-4245.

G. Pest control for plants shall be in accordance with the "2006 Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs", published by Cornell University, Ithaca, NY. This publication is available from The Resource Center, Cornell University, Ithaca, NY 14853. Telephone (607)-255-9946.

H. All materials, activities and procedures shall be in accordance with the Federal Aviation Administration (FAA) – Advisory Circular No. 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports", August 28, 2007.

I. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, Current Edition, Northeastern Regional Publication No. 493 as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the soil and backfill materials temperature at each planting area shall be above 32 degrees Farenheit.

2. Perform planting and soil related operations only when no form of precipitation is falling or forecast to fall within the next 2 hours. Following a period of precipitation, resume operations only after the soil has drained.

B. Planting Calendar Limitations

Planting shall be performed only during the following periods:

Deciduous Plants:	March 1 - May 1 and October 15 - December 1
Evergreen Plants:	April 1 - May 15 and September 1 - October 15
Perennials	April 1 – July 1

1.04 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity and its workers performing the Work of this Section are experienced in landscaping and have been engaged in work of a complexity similar to that required under this Section for a period of at least five years.

2. Verify that the entity performing pesticide applications shall have a valid license as a commercial pesticide applicator by the state in which the Work is being performed.

3. Verify that the entity performing pruning, planting, inspections and maintenance of this Section is a current member of the International Society of Arboriculture (ISA) and State Chapter where it is located.

4. Verify that the entity performing the work of this Section employs a New Jersey Licensed Tree Expert who possesses a minimum of the following:

   a. Associate's Degree in Horticulture from a recognized college.

   b. A total of five (5) years of work experience.

   c. Membership in the International Society of Arboriculture and State Chapter where he resides.

d. Licensed as a Tree Expert by the New Jersey Board of Tree Experts during the year(s) this individual is working on this Contract.

e. Quality Assurance.

(1) Qualifications: Verify that the entity performing the Work of this Contract utilizes the services of a New Jersey Licensed Tree Expert who shall accompany the Engineer to inspect trees at the Nursery where they are grown, acts as superintendent for the installation and all maintenance of plantings for this Contract and who shall be on site at all times including but not limited to: plant material deliveries, maintenance of plants at the site after delivery and prior to installation, verifying the trunk flare and the presence of girdling roots on all trees prior to planting, planting, staking, mulching, pest management and application of bio-stimulants to all plant materials. The Licensed Tree Expert (NJ) shall notify the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

5. Verify that the laboratory performing the laboratory testing of this Section is a certified testing laboratory such as the Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850,or an approved equal in either the State of New Jersey or New York and shall have experience in soil testing for soil properties important for plant and turf management and shall perform all tests as specified in 2.01 A, 2.01 B and as outlined in Appendix B and Appendix C of this Section.

B. General Requirements for Operations and Products

1. Products listed in PART 2 – PRODUCTS shall be approved in writing by the Engineer prior to their delivery to the construction site.

2. After delivery to the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Immediately remove from the construction site products which fail to comply with these specifications and replace with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these Specifications.

3. Obtain, retain, and make available for on-site inspection at all times, U.S. Department of Labor Material Safety Data Sheets for all toxic substances and hazardous materials to be used in this Contract. Give one copy of said sheets to the Engineer for review and approval prior to introduction of material to the construction site.

4. All plant materials shall be grown in nurseries located within the following states: Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

5. All plant material shall be 'Nursery Grown.' Nursery Grown shall mean that the fields from which the plants are to be obtained are from active and working nurseries where the following horticultural practices have been aggressively performed:

a. IPM Program - Integrated Pest Management Program

b. Cultivation - Including weed suppression

c. Fertilization

d. Pruning

e. Irrigation

Any plant material from a field where the above horticultural practices have not been consistently practiced in the last twelve (12) months will be rejected.

6. Pesticide

a. Select to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.

b. Prepare and maintain all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within 5 days when so requested.

c. Not less than forty-eight hours prior to a proposed spray operation, submit to the Engineer for his approval a tabulated list indicating the target to be treated, the chemical trade name and quantity of mix being prepared.

d. All pesticide/herbicide applications will be subject to inspections by the Engineer. The Engineer may at any time suspend and reschedule a pesticide/herbicide application when, in his determination, weather conditions are unfavorable, facility operations would be hampered or the Contractor's methods or materials fail to comply with these Specifications.

7. Asian Longhorned Beetle

a. Be able to identify and be aware of the possibility of encountering the Asian Longhorned Beetle. If beetles are observed or are suspected of being present, immediately notify the Engineer and contact : New Jersey Department of Agriculture, Division of Plant Industry, P.O. Box 330, Room 303, Trenton, NJ 08625-0330; Telephone: (609)-292-5441.

C. Specific Requirements for Operations and Products

1. Plants

a. Coordinate all arrangements and accompany the Engineer on all inspections of plants at the nursery. Provide a minimum of 48 hours prior notice to the Engineer. Do not dig or remove any plant prior to inspection by the Engineer.

b. All plants selected by the Engineer at the nursery will be sealed with Authority seals, or at the discretion of the Engineer, typical representative numbers of such plants may be sealed.

c. Deliver to the construction site plants which were sealed and whose seal numbers conform to the Engineer's nursery inspection records.

d. Unsealed plants that, in the sole opinion of the Engineer, are not equal in quality to the sealed samples will be rejected.

e. Each shipment shall be certified by Federal and State authorities to be free of insects and diseases. Arrange for inspection certificates to this effect that would be required by law, if the Authority were a private corporation, to accompany each shipment invoice and to be delivered to the Engineer.

f. All plants, sealed or unsealed, will be subject to tailgate inspection upon arrival at the construction site. All plants failing to meet the requirements of this Section will be rejected by the Engineer. Remove rejected plants from the construction site and replace at no additional cost to the Authority.

g. At the discretion of the Engineer, typical representative numbers of plants may be removed from their growing containers for inspection.

2. Drive/Walk Through Site Inspections

a. During the landscape installation period (prior to rendition of a Certificate of Final Completion), the Contractor's Licensed Tree Expert (NJ) and the Contractor shall perform weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer, to address the following:

(1) Identify the status/progress of Work.

(2) Identify issues or problems requiring immediate action by the Contractor.

(3) Identify items affecting the Contractor's schedule for completion of Work.

b. Within 48 hours of each site inspection, arrange for the Contractor's Licensed Tree Expert (NJ) to submit a report stating the following:

(1) Site inspection Attendees.

(2) Agenda and items discussed.

(3) Description of issues/problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

3. Screened Loam soil

a. Prior to delivery to the construction site, submit a representative sample of screened loam soil for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01 A. No substitution for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 A and Appendix B of this Section.

b. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

c. Prior to delivery of screened loam soil to the construction site, submit to the Chief of Materials Engineering the following:

1.) The location of the source of the screened loam soil and the name and address of the supplier.

2.) A certified analysis of the loam soil that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation" for the crop "Landscape Plants".

4.) One, two-pound sample for each 100 CY of Screened Loam soil required, to the Chief of Materials Engineering.

d. Do not deliver screened loam soil to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

e. After delivery of screened loam soil to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01.A. Submit test results to the Chief of Materials Engineering for approval for up to each 100 Cubic Yards of screened loam soil delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened loam soil from the construction site and replace it with material that does conform, at no cost to the Authority.

4. Planting Mix

a. Do not combine planting mix components until components have been approved in writing by the Chief of Materials Engineering.

b. After planting mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the planting mix to a certified independent laboratory to ensure conformance to requirements specified in 2.01 B. No substitutions for testing parameters will be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 B and Appendix C of this Section.

c. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

d. Prior to delivery of planting mix to the construction site, submit to the Chief of Materials Engineering the following:

1.) The location of the source of the planting mix and the name and address of the supplier.

2.) A certified analysis of the planting mix that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation"for the crop

Botanical Name	Common Name
Gleditsia Triacanthos Inermis	Honeylocust
Larix Laricina	American Larch
Quercus Alba	White Oak
Quercus Palustris	Pin Oak
Quercus Rubra	Red Oak
Tilia Americana	American Linden
Picea Abies	Norway Spruce
Picea Glauca	White Spruce
Picea Pungens Glauca	Colorado Blue Spruce
Pinus Strobus	Eastern White Pine
Amelanchier x grandiflora Cumulus	Cumulus Serviceberry

Cercis canadensis "Forest Pansy"	Forest Pansy Redbud
Prunus Okame	Okame Cherry

4.) One, two pound sample for each 100 CY of planting mix required, to the Chief of Materials Engineering.

5.) A letter certifying that the source components and their suppliers, of the planting mix are all as approved by the Chief of Material Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.

e. Do not deliver planting mix to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

f. After delivery of planting mix to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 B. Submit test results to the Chief of Materials Engineering for approval for up to each 100 CY of planting mix delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered planting mix from the construction site and replace it with material that does conform, all at no cost to the Authority.

5. Compost

a. Prior to delivery of compost to the construction site, submit to the Chief of Materials Engineering the following:

1). The location of the source of compost and the name and address of the supplier.

2). A certified analysis of the compost that it meets the specification herein. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

3). A ¼ pound sample.

4). In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

D. Certification

1. Verify that the concentration of environmental parameters in all soil mixes shall not exceed the NJDEP's Residential Direct Contact Soil Cleanup Criteria as stated in N.J.A.C. 7:26D..

2. A letter certifying that the source components and their suppliers for the planting mix are all as approved by the Chief of Materials Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.

E. Replacement

1. Replace unsatisfactory furnished and installed plants which, in the sole opinion of the Engineer, have died or have otherwise become unsatisfactory.

2. Replace unsatisfactory plants with products and by operations that comply with all requirements of these Specifications, and on such date(s) as ordered by the Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products in a legal manner.

D. Specific Requirements

1. Screened Loam Soil, Planting Mix and Compost.

Conform to requirements of 1.04 C.3, 1.04 C.4. and 1.04 C. 5.

2. Trees, Shrubs and Ground Cover

Conform to requirements of 1.04 C.1 and as follows:

a. Transport plants in covered trucks only. Plants transported on open trucks from the nursery will be rejected by the Engineer.

b. Do not stack plants on top of one another at any time during delivery and transport to the construction site or during storage prior to installation.

c. Carry plants by the ball or container and not by stems.

d. Do not drop plants.

e. Protect all delivered plants from drying out by providing shade and water. Do not allow plants to become dry or wilted.

f. After plants have been set on the ground, apply water as needed, and cover balls with a thick layer of plastic sheeting or shredded hardwood bark mulch.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Screened Loam Soil

Fertile, friable, natural loam soil, free of subsoil, taken from a depth of no more than 1 foot, or less if subsoil is encountered, supplier-certified as having been obtained from an area which has never been treated with herbicide and conforming to the following:

1. Screened loam soil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass and any other undesirable material.
2. Provide a soil nutrient analysis providing the percentage Nitrogen (N), Phosphorus (P) and Potassium (K) in pounds per Acre.
3. Provide soil micronutrient analysis providing the percentage of Zinc, Copper, Manganese, Boron and Iron, in parts per million.
4. Screened loam soil shall contain a minimum of 5 percent organic matter and maximum of 7 percent organic matter as determined by loss of ignition of moisture-free samples.
5. pH range shall be 5.0 to 7.0, inclusive.
6. The range of soluble salts shall be equal to or less than 500 micromhos per centimeter.
7. Screened loam soil shall be graded as follows:

Passing	Retained On	Percentage
1" screen		100%
1" screen	2mm (No.10) Sieve	Not more than 40%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

8. The portion of screened loam soil passing the 2mm sieve, based on the mechanical analysis of the soil as determined by the Buoyoucous Hydrometer method, shall consist of the following based on dry weight of sample:

a. Sand 40% - 60%, inclusive

b. Silt 30% - 40%, inclusive

c. Clay 10% - 30%, inclusive

B. Planting Mix

Composed of screened loam soil, various soil amendments and nutrient control materials conforming to the following:

1. Planting mix shall contain a minimum of 7% and a maximum of 15% organic matter as determined by loss on ignition of moisture free samples, and the pH range of 5.0 to 7.0, inclusive, with 60% passing a 1" screen.
2. The range of soluble salts shall be equal to or less than 1250 micromhos per centimeter.
3. Each 5 cubic yards of planting mix shall contain:

a. 3 3/4 cubic yards of screened loam soil;

b. 1 1/4 cubic yards of compost

c. 17 lbs. of Hydrogel

4. Planting mix shall be loose, friable and not frozen or saturated at the time of mixing.

C. Compost

1. Compost shall be derived from biosolids, free of viable weed seeds and contain material of a generally humus nature. The product shall not contain any materials toxic to plant growth or produce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. Variations in the following specified physical properties are not acceptable. Compost shall conform to the following: .

Parameters:	Range:
pH	5.7 – 7.7
Moisture Content	35% - 55%
C: N Ratio	15 – 30:1
Organic Matter	40% - 50%
*Soluble Salts – Saturated Paste Method	< 5.0 mmhos/cm (ds/m)
Nitrogen	> 1.5%
Phosphorus	< 20%
Potassium	< 0.5%
Maturity Index	7-8

*See Appendix "D" for allowable compost application rates based upon soluble salts levels.

D. Weed Control

1. Pre-emergent Herbicide

"Treflan 5G" as manufactured by Elanco Products Co., Indianapolis, IN 46285 or approved equal.

2. Post-emergent Herbicide/Glyphosate.

"Roundup Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

E. Hydrogel

1. "Viterra Gelscape" as manufactured by Amereq, Inc., New City, NY 10956.
2. "Super Sorb" as manufactured by Aquatrols Corps of America, Inc., Cherry Hill, NJ 08003.
3. "Soil Moist" as manufactured by JRM Chemical Inc., Cleveland OH 44125
4. "AquaGel A, B, C, D" as manufactured by Profile Products, Buffalo Grove, IL 60089
5. Or approved equal.

F. Nursery Stock

1. Furnish trees, shrubs, ground cover and perennials in the quantity, species, and meeting the size, height and width requirements shown on the Contract Drawings.
2. Furnished plants shall conform to the following:
   a. Measure plant size as it stands in its natural position.
   b. Conform to tree caliper, shrub sizes, heights and widths as shown on Contract Drawings.
   c. For container grown plants, if used, conform to the dimensions for height, width, number of canes and container size as shown on the Contract Drawings.
   d. For B & B grown plants, if used, do not install or leave in the planting hole any "No Rot" treated burlap or twine. Remove the "No Rot" burlap and twine in it's entirety and dispose of in a legal manner away from PA property.
   e. Plants furnished shall be an average of the minimum and maximum sizes shown on the Contract Drawings.
   f. Do not use large plants cut back to sizes specified.
   g. Plants shall be sound, healthy, vigorous growing specimens.
   h. Plants shall exhibit uniform growth and a form characteristic of their species.
   i. With respect to their canes, trunks, stems, and branches, shrubs shall:
      (1) Have normal, well-developed canes and branches.
      (2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sun-scald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, damage due to machinery operation, improper pruning and blasted buds.
   j. Plants' foliage shall be free from chlorosis, yellowing, blemishes and damaged parts.
   k. Plants shall have vigorous, fibrous root systems.
   l. Container grown plants, if used, shall have been grown in the container long enough to develop new fibrous roots so that the root mass will retain its shape and hold together when removed from the container. Recently potted or root-bound plants shall not be accepted by the Engineer. Container-grown plants shall be free from girdling roots.
   m. With respect to their trunks and branches, trees shall:
      (1) Have normal, well-developed branches.

(2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sun-scald injuries, abrasions of the bark, girdled trunk or branches, head malformed from over crowding within Nursery fields, damage due to machinery operation, improper pruning and blasted buds.

(3) Have straight trunks with a sturdy central leader. Clump forms may have more than one straight leader. Lateral branches shall arise near right angles forming a U-shaped crotch. Trees with V-shaped crotches will be rejected by the Engineer.

(4) Have been properly pruned to ensure a strong, sturdy and symmetrically shaped canopy.

(5) Root flare exposed and no native soil or container soil found to be above the tree's or shrub's natural root flare at the trunk.

(6) Whenever, the root flare is not exposed, an airspade shall be employed to expose the natural root flare. The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

n. With respect to their roots, trees shall:

(1) Be free from girdling roots.

(2) If girdling roots are present, have the Licensed Tree Expert (NJ) remove them at no cost to the Authority.

(3) If it is determined that the girdling root cannot be satisfactorily removed by the Contractor's Licensed Tree Expert (NJ), immediately remove the affected tree and replace it with a tree that meets this specification, at no additional cost to the Authority.

(4) Bareroot plants will be prohibited.

3. Instructions for digging and balling plants are as follows:

a. Dig immediately before moving.

b. Dig to retain as many fibrous roots as possible.

c. Do not use loose, broken or manufactured balls.

d. Wrap and tie balled and burlapped plants with untreated burlap and sisal or jute twine. Do not ball and tie with treated (or "no rot") material.

e. Trees - Trunk Flare

(1) Trees shall have all excess soil removed from the top of the true root ball and full exposure of trunk flare, prior to ball and burlap operations at the Nursery.

(2) The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

(3) Trees delivered to the construction site with 2" depth (or greater) of excess soil on top of the true root ball, girdling roots and unexposed trunk flare will be rejected by the Engineer.

G. Soil pH Adjustment

1. Soil pH adjustment

a. Elemental Sulfur

Guaranteed analysis shall be

0% Nitrogen

0% Phosphorus

0% Potassium

90% Sulfur

b. Granulated Dolomitic Limestone

As manufactured by Southdown, Inc., Lee, MA 01238, or approved equal conforming to the following:

(1) Total carbonates not less than 86% of 48.2% calcium oxide equivalent. For purposes of calculation, total carbonates shall be considered as calcium oxide. Magnesium oxide content shall be between 15-22%.

(2) A dust-free, homogenous, granular material.

H. Fertilizer/Bio-Stimulants (Trees)

1. Fertilizer

a. Fertilizer shall be 'Healthy Start 12-8-8 Macro Tabs', 21 gram tablets, as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:.

Essential Element Ingredient:	% Analysis by Weight:*
Nitrogen	12.0% (8% controlled release)
Phosphorus	8.0%
Potassium	8.0%
Calcium	2.0%
Sulfur	1.0%
Magnesium	0.2%
Iron	0.2%

*Organic forms derived from Ureaform (Nitroform), Methlene Ureas (Nutralene), Ammoniated Phospates, Bone Meal, Blood Meal, Kelp Meal, Feather Meal, Sulphate of Potash, Longbeinite, Humates, Whey Protein and Rice Bran.

Soil Conditioner Ingredients:	Derived From:
Humic Acid (Minimum 12% by weight)	Natural Humates
Natural Sugars, Dried Yeast & Other Carbohydrates	Processed Grain Byproducts
Amino Acids	Animal and Plant Proteins
Yucca Plant Extract (Wetting Agent)	Yucca schidigera

Sea Kelp (Biostimluant)	Ascophylum nodosum

Beneficial Bacteria:	Per 21 Gram Tablet:
Nitrogen-Fixing Bacteria Spores	2 million
Phosphorous-Solubilizing Bacteria Spores	2 million
Growth-Promoting Bacteria Spores	2 million

2. Bio-Stimulants

a. Bio-stimulants shall be 'Mycor-Tree Saver Transplant' as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:

Ingredients:	Analysis (per 3 ounce packet):
Live Spores of VA Endomycorrhizal Fungi	Minimum of 1000 Spores of Vesicular-Arbuscular (VA) Fungi. Includes: Entrephospora columbiana, Glomus etunicatum, Glomus clarum and Glomus sp.
Live Spores of an Ectomycorrhizal Fungus	Minimum of 60 million spores of Pisolithus tinctorius.
Terra-Sorb HB Water Absorbent Gel	Acrylamide copolymer gel
Dry Soluble Yucca Plant Extract	Yucca schidigera
Soluble Sea Kelp Extract	Ascophylum nodosum
Humic Acids	Leonardites Humates

I. Fertilizer/Bio-Stimulants (Shrubs, Ground Cover and Perennials)

a. Fertilizer/Bio-Stimulant shall be a granular, organic fertilizer and soil conditioner with beneficial mycorrhizal fungi and nitrogen-fixing/phosphorus solubilizing bacteria. Fertilizer/Bio-Stimulant shall be 'Mycor 4-7-4 + Micros Plant Saver', as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, (800)-421-9051 or an approved equal conforming to the following:

Beneficial Mycorrhizal Fungi Bacteria:	Analysis (per 4 ounces)
Live Spores of VA Endomycorrhizal Fungi	Minimum of 300 Spores of Vesicular-Arbuscular (VA) Fungi. Includes: Entrephospora columbiana, Glomus etunicatum, Glomus clarum and Glomus sp.
Live Spores of an Ectomycorrhizal Fungus	Minimum of 10 million spores of Pisolithus tinctorius.
Nitrogen-Fixing Bacteria	Approx. 50 million per pound

Phosphorus-Solubilizing Bacteria	Approx. 50 million per pound
Growth Promoting Bacteria	Approx. 50 million per pound

Soil Conditioner Ingredients:	Derived From:
Humic Acid (Minimum 15% by Weight)	Natural Humates
Complex Carbohydrates and Dried Yeast	Processed Grain Byproducts
Amino Acids	Animal and Plant Proteins
Yucca Plant Extract (Wetting Agent)	Yucca schidigera
Sea Kelp Extract (Biostimulant)	Ascophylum nodosum

Guaranteed Nutrient Analysis 4-7-4:

Nutrient:	% Analysis By Weight:
Nitrogen (N)	4.0%
Phosphate (P2O5)	7.0%
Potassium (K2O)	4.0%
Calcium (Ca)	6.0%
Sulfur (S)	2.4%
Magnesium (Mg)	3.0%
Iron (Fe)	3.0%
Manganese (Mn)	0.7%
Zinc (Zn)	0.4%

J. Pruning Alcohol

1. A commercial ethylalcohol or "Ethanol" 70-95%.

M. Tree Staples

1. Tree staples shall be uncoated, cold-rolled, plain carbon steel as manufactured by Tree Staple, Inc., 139 South St., New Providence, NJ 07974, (877) 873-3749, as per U.S. Patent No.'s 141, 903 & 6,065,243.
2. Staple sizes shall as shown on the Contract Drawings and identified as follows:

Stake Model	Planting Size	Number of Staples/Tree
TS24-8-8	1" – 2" caliper	Min. 2 per tree
TS36-10-10	2" – 4" caliper	Min. 2 per tree
TS42-12-12	4" – 6" caliper	2 – 3 per tree
TS48-12-12	6" – 8" caliper	2 – 3 per tree

3. Tree Staples are available from the following suppliers:

a. NYP Corp., 805 East Grand St., Elizabeth, NJ 07201

b. Northern Nurseries, 487 Elizabeth Ave., Somerset, NJ 08873

c. Northeastern Supply, 50 Notch Rd., West Paterson, NJ 07836

d. Or approved equal.

N. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

O. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:

a. Constructed of ultra-violet-light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.

b. Each TreeGator bag to have a 20 gallon water capacity and weigh 1 ½ pounds empty.

2. TreeGator Junior portable drip irrigation system shall conform to the followng:

a. Constructed of PVC with reinforced heat-sealed seams and removable vinyl emitter-system, which shall consist of a PVC-L Valve and a PVC Emitter Insert.

b. Each TreeGator Junior to have a 14 gallon water capacity

3. TreeGator portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187 or approved equal.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that final grades have been established prior to start of planting operations.

B. Inspect trees, shrubs and ground cover for injury, wilting, pest infestation, location of the root flare in comparison to top of root ball or container, girdling roots and improper pruning. Do not plant until deficiencies are corrected, or plants are replaced.

3.02 PREPARATION

A. Areas of Changed Grades

Verify that areas of changed grades, which are to be landscaped as shown on the Contract Drawings, are in conformance with the grading plans and have a smooth, uniform surface. Rototill subgrade to a minimum six (6) inch depth. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials.

Subgrade shall be defined as either clean fill soil or in-place soil found after removing the required existing soil or existing pavement and existing base subgrade as shown on the drawings.

B. Areas to receive "Shrub and Perennial Mass" plantings [Screened Loam Soil (Section 02921) and Compost (Section 02960)] .

1. Apply six (6) inches of screened loam soil and two (2) inches of compost to all areas to receive landscape plantings in two lifts of three (3) inches screened loam soil and one (1) inch of compost.

2. Rototill the first lift of three (3) inches screened loam soil and one (1) inch of compost into the existing subgrade in order to achieve an homegeneous mix.

3. Add the second lift of three (3) inches screened loam soil and one (1) inch of compost and rototill the screened loam soil and compost in order to achieve an homogeneous mix.

3.03 INSTALLATION

A. Excavation of Plant Pits

1. For balled and burlapped plants (B&B) and container grown plants, excavate soil from plant pits to conform to the following:

Size of Ball or Container	Diameter of Hole	Depth Below Bottom of Ball or Container
Less than 4 feet diameter	2 x diameter of ball or container	6 inches
4 to5 feet diameter	1-3/4 x diameter of ball or container	8 inches
Over 5 feet diameter	1-1/2 x diameter of ball or container	8 inches

2. Prior to planting, excavated plant pits shall be subject to Engineer's approval.

3. At no time shall excavated material be stockpiled on site. Remove excavated material immediately from the construction site and dispose of in a legal manner.

B. Trees: Trunk Flare and Girdling Root Verification

1. Verify and locate the top elevation of the true root ball and remove any excess soil depth to expose trunk flare at the base of the tree trunk prior to lifting and transporting tree into excavated plant pit.

2. Remove any excess soil located on top of the root ball, expose the trunk flare as shown on the Contract Drawings and remove girdling roots as directed by the Engineer and at no additional cost to the Authority. Arrange for all work to be provided by the Contractor's Licensed Tree Expert (NJ) at no additional cost to the Authority.

3. The top elevation of the true root ball shall be even with or no more than 2" higher than adjacent finished grade elevations.

4. Do not plant trees until the trunk flare has been exposed, all girdling roots removed, and the top elevation of the true root ball has been established and approved by the Engineer.

5. Perform all work and verification in the presence of the Contractor's Licensed Tree Expert (NJ) and the Engineer.

C. Planting Operations

Plant only in the presence of the Engineer, and as follows:

1. Planting B & B and Container Grown Plants

a. Handle plants so that the root ball will not be loosened. Do not handle trees by their trunks and shrubs and ground cover by their stems when transplanting or shifting plants.

b. Set plants plumb.

c. Set tree so that top of root ball is level with the finished grade after settlement.

d. For container grown plants, carefully remove the container and cut edge-roots with knife on three sides, taking care not to damage the roots. Carefully loosen the roots by hand from the container potting media and gently spread the roots out into the planting mix backfill.

e. For B & B plants, after the planting mix has been thoroughly firmed under and around the ball, cut and remove burlap away from the collar and from the upper half of the ball and adjust the remaining burlap to prevent the formation of air pockets. Remove wire baskets from root balls entirely. Where directed by the Engineer, remove burlap entirely. Prune and remove girdling roots and perform all necessary tree pruning under the supervision of the Contractor's Licensed Tree Expert (NJ) and the Engineer.

f. Avoid bruising or breaking roots when tamping soil.

g. Firm planting mix at 6- to 8-inch intervals and thoroughly settle it with water.

i. After planting, thoroughly saturate the soil around each tree with water.

2. Fertilizer/Bio-Stimulants

a. Fertilizer/Bio-Stimulants (Trees)

(1) Provide one (1) application of each Fertilizer/Bio-Stimulant to all trees installed under this Contract, during the initial installation of each tree, as supervised by the Contractor's Licensed Tree Expert (NJ) and the Engineer.

(2) Apply twenty-one (21) gram fertilizer tablets at time of planting operations as per the manufacturer's directions and as follows:

Tree Root Ball Size:	Quantity of 21 Gram Fertilizer Tablets Req:
18"-28" Diameter	5 Tablets
30"-38" Diameter	6 Tablets
42"-48" Diameter	8 Tablets
54"-70" Diameter	10-12 Tablets

(3) Incorporate bio-Stimulants into the top 8" of planting mix around the root ball after the tree has been planted as per the manufacturer's directions and as follows:

Tree Root Ball Size:	Quantity of 3 Ounce Packets Required:
18"-28" Diameter	2 Packets
30"-38" Diameter	3 Packets
42"-48" Diameter	4 Packets
54"- 70" Diameter	5 Packets
70" Diameter	6 Packets
80" Diameter	7 Packets

(4) Bio-Stimulant Application Method:

(a.) Place the tree into planting pit and backfill with planting mix to within 3"-4" from top of root ball.

(b.) Evenly spread the contents of bio-stimulant packets into a "doughnut shaped" ring up to 8" in width around the outside edge of the root ball.

(c.) Backfill remaining 3"-4" with planting mix.

(d.) Thoroughly mix the top 3"-4" planting mix by hand, around the edge of the root ball up to 8" wide to a depth of approximately 8".

(e.) Pack firmly and water to soil saturation.

b. Fertilizer/Bio-Stimulants (Shrubs,Ground Cover and Perennials)

(1) Provide one (1) application of Fertilizer/Bio-Stimulants to all shrubs and ground cover installed under this Contract, during the initial planting installation, as supervised by the Contractor's Licensed Tree Expert (NJ) and the Engineer.

(2) Incorporate Fertilizer/Bio-Stimulants into the top 6"-8" of planting mix of plant pits of each shrub and ground cover during the initial planting installation, as per the manufacturer's directions and as follows:

Plant Container/Root Ball Size:	Application Rates (Per 4 Ounce Scoop):
1 Gallon Container	One Scoop (4 Ounces)
2 Gallon Container	One Scoop (4 Ounces)
3 Gallon Container / 10" Root Ball	Two Scoops (8 Ounces)
5 Gallon Container/ 12"-14" Root Ball	Two Scoops (8 Ounces)

D. Tree Stapling

1. Install as shown on the Contract Drawings.

2. Submit written verification from the manufacturer that Tree Staples have been installed according the manufacturer's instructions.

E. Edging of Planting Areas

1. Establish a neat edge where planting areas meet turf areas as shown on the Contract Drawings.

2. Edge with a spade or edging tool immediately after planting and seeding is completed.

F. Mulching

1. Cultivate and rake planted areas and leave in an orderly condition.

2. On level ground or slight slopes, leave a shallow basin a little larger than the diameter of the plant pit as shown on the Contract Drawings.

3. Place a minimum of 2 inches of shredded hardwood bark mulch in the plant basin. Depth of mulch shall not exceed 3 inches.

4. Wherever trees, shrubs, ground covers and perennials have been planted in a continuous bed, apply a minimum of 2 inches of shredded hardwood bark mulch over the entire planting bed. Depth of mulch shall not exceed 3 inches. Exposed bare soil will not be acceptable.

5. Maintain a minimum radius of 4 inches between the tree or shrub trunk flare and the start of the mulch.

6. Mulch volcanoes are prohibited. Whenever mulch is inappropriately applied, remove the inappropriately installed mulch from the construction site and replace it in conformance with the original Contract Drawings, at no cost to the Authority.

G. Irrigation

1. Commence irrigation immediately after planting using TreeGator bags and maintain as required until issuance of Certificate of Final Completion.

2. Thoroughly water all plant materials at time of installation. Thereafter adhere to the following minimum watering schedule:

   a. Week one following planting: Fill TreeGator bags daily.

   b. Week two following planting: Fill TreeGator bags three days per week

   c. Week three through week Twelve: Fill TreeGator bags two days per week

   d. Week Twelve through issuance of Certificate of Final Completion: Fill TreeGator bags one day per week.

3. Increase or decrease frequency of watering as determined by monitoring the local weather observations and predictions provided by the National and Local Forecast, Hurricane, Radar and Report as published by the Weather Channel.

H. Plant Maintenance

1. Maintain plantings as per Section 02972 – Maintenance of Permanent Plantings & Hardscape (NJ) and by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep shrubs free of insects and disease.

2. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

3. Apply treatments as required to keep plant materials, planted areas and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

I. Arborist's Site Inspections/Reports

1. During the installation period (prior to rendition of a Certificate of Final Completion), make available the Contractor's Licensed Tree Expert (NJ) who, accompanied by the Contractor and the Engineer, shall perform weekly drive and walk through site inspections of the construction site, identifying the status of the installation work, issues or problems requiring immediate action by the Contractor and items affecting the Contractor's work schedule.

2. Within 48 hours of each site inspection, transmit from the Contractor's Licensed Tree Expert (NJ) a 'Site Inspection Report', to include but not be limited to: list of inspection attendees, item(s) discussed, a brief description of the issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates by which the Contractor will implement said Work.

END OF SECTION

SECTION 02954
TREES, SHRUBS AND GROUND COVER
(NEW JERSEY)

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of 'Inspections and Rejections' of Division 1 - General Provisions.

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the Testing laboratory performing the work of this Section.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of the Entity's membership to the International Society of Arboriculture and State Chapter where it is located ion accordance with 1.04.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications in writing for approval by the Engineer of the New Jersey Licensed Tree Expert performing the Work in accordance with 1.04 A.4. Include the name of the arborist, a copy of the New Jersey Tree Expert's License, resume and a description and contract amounts for work performed in the last two years.

4. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone number, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

5. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of a valid pesticide applicators license, in the state in which Work is to be performed.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS:

   a. A complete "Products List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.

   b. Material Data Safety Sheets for all toxic or hazardous materials to be used under this Section.

   c. A complete "Plant List", listing all nursery sources for all trees, shrubs, ground cover and perennial plantings; including written verification according to 1.04B4, 1.04 B5 and 1.04 C1.

2. Submit the location of the source and the name and address of the supplierof the screened loam soil, planting mix and compost and a representative samples (as many as required) to the Chief of Materials Engineering in accordance with 1.04 C.3., 1.04C.4 and 1.04 C5.

C. Test Reports

Submit laboratory analyses of screened loam soil, planting mix and compost to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 1.04 C 3, 1.04 C 4, 1.04 C5, Appendix B and Appendix C. After initial approvals, thereafter, submit one laboratory analysis for up to each 100 CY of screened loam soil, planting mix and compost delivered to the construction site.

D. Certifications

1. Submit plant inspection certificates, in accordance with requirements of 1.04 C.1.e.
2. Submit to the Chief of Materials Engineering certification required by 1.04 D.
3. Submit certification from the Tree Staple manufacturer.
4. A letter certifying that the source components and their suppliers, of the planting mix are all as approved by the Chief of Material Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.
5. Submit verification that B& B and container grown plants are in accordance with 2.01 F and 3.02 B.
6. Submit verification that final grades have been established prior to start of planting operations..

E. Arborist's Site Inspection Reports

1. Within 48 hours of each weekly site inspection, transmit from the Contractor's Licensed Tree Expert (NJ) a 'Site Inspection Report' in accordance with the requirements of 1.04.C.2.

END OF APPENDIX "A"

SECTION 02954
TREES, SHRUBS AND GROUND COVER
(NEW JERSEY)

APPENDIX "B"

Material: Screened Loam Soil

Specification: Section 02921 – Screened Loam Soil

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 5% Max. 7%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 500 Max. 300		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent – Silt	30% - 40%		
Percent - Clay	10% - 30%		

END OF APPENDIX "B"

SECTION 02954
TREES, SHRUBS AND GROUND COVER
(NEW JERSEY)

APPENDIX "C"

Material: Planting Mix

Specification: Sections 02954 & 02972

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 7% Max. 15%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 1250 Max. 750		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 30%		

END OF APPENDIX "C"

SECTION 02954

TREES, SHRUBS AND GROUNDCOVER (NEW JERSEY)

APPENDIX "D"

COMPOST – SOLUBLE SALTS LEVELS

Use the following table* to determine the maximum allowable ECe(dS/m of saturation extract) of compost at the desired application rate:

Desired Use Rate		Salinity (ECe) of On-Site Soil		
Cubic Yards Amendment per 1000 Sq. Ft. for incorporation to 6" depth	Volume Percentage of Amendment	3 dS/m	2 dS/m	1 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9. 5	14
4	22	3. 5	7	10. 5
5	27	3	5. 5	8. 5
6	32	2. 5	4. 5	7

Example: If Specification calls for 6 cubic yards compost per 1000/sq. ft. to be incorporated into the top 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding an ECe of 4 in the final blend, compost ECe should be less than 4.5 dS/m.

* This table is as per "Compost – A Guide for Evaluating and Using Compost Materials as Soil Amendments", by William Darlington, Soil & Plant Laboratory, Inc. as published by the University of California Extension Service, Orange County Office.

END OF APPENDIX "D"

DIVISION 2

SECTION 02958

TREE REMOVAL AND DISPOSAL (NEW YORK)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for tree removal and disposal.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

B. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Road, Suite 101, Londonderry, NH 03053.

1.03 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity and its workers performing the Work of this Section are experienced in tree pruning and removal and have been engaged in work of a complexity similar to that required under this Section for a period of at least three years.

2. Verify that the entity performing Work of this Section is a current member of the International Society of Arboriculture (ISA) and State Chapter where it is located.

3. Verify that the entity performing the work of this Section retains a New York Certified Arborist who possesses a minimum of the following:

   a. Associate's Degree in Horticulture from a recognized college.

   b. A total of five (5) years of work experience.

   c. A current member of the International Society of Arboriculture and State Chapter where they are resideing.

   d. Qualified by the International Society of Arboriculture during the year(s) this individual is working on this Contract.

e. Quality Assurance.

(1) Qualifications: Ensure that the entity performing the Work of this Contract retains the services of a New York Certified Arborist who shall act as superintendent for tree crown reduction, pruning and removals for all trees for this Contract and shall be on site at all times including but not limited to: scoping out the project with the Engineer prior to any tree work, verifying and supervising tree crown reduction, pruning and removal and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

f. Verify that the entity performing the Work of this Contract owns, at a minimum, the following pieces of equipment:

(1) One (1) Aerial Bucket Truck

(2) One (1) Boom Truck

(3) Two (2) Brush Chippers

(4) Two (2) Forestry Trucks

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be as approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with this specification shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these Specifications.

3. Asian Longhorned Beetle

a. The Contractor shall be aware of the possibility of encountering the Asian Longhorned Beetle. If beetles are observed or suspected of being present, the Contractor shall immediately notify the Engineer and is requested to contact : New York State Department of Agriculture & Markets at (800) 554-4501 extension 72087, or the ALB hotline at (877) STOPALB (877-786-7252). (Division of Plant Industry, Kevin S King, Director (518)457-2087) and the Staten Island Borough Forestry Office at NYC Parks & Recreation Attn: FORESTRY 1150 Clove Rd. Staten Is., NY10301, Fx: (718) 816-9194, Ph: (718) 390-2080. NYC Parks and Recreation will remove all infested NYC park and street trees.

b. If the Contractor is operating in or adjacent to any New York State or New York City quarantine area for the Asian Longhorned Beetle, then he shall comply with all City, State and Federal regulations. Regular updates are provided on: http://www.dec.ny.gov/animals/7255.html and http://www.nycgovparks.org/trees/beetle-alert

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application, and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products away from Authority property.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

No Work shall proceed prior to receiving written approval of the qualifications of the entity, laborers, certified arborist and evidence of equipment ownership as specified in this Section.

PART 2. PRODUCTS

2.01 MATERIALS

A. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

B. Equipment

1. The Contractor shall provide all necessary equipment and supplies required to perform the work of these Specifications.

2. Equipment shall include but not be limitied to mechanical equipment including aerial bucket trucks, forestry trucks, stump cutters, brush chippers, tree trimmers, log splitters and other similar equipment, and hand equipment including wheel barrows, pruning tools and other similar hand equipment.

3. Equipment shall also include basic skyworker/trim lift tools including but not limited to the following: hydraulic chain saw, manual pole saw (2), lopping shears, gas powered chain saw, hand saw with scabbard (2), ax, gas powered topping saw (2), one-half inch 120 foot long climbing line (2), climbing saddles (2), wheel chucks, extra chainsaw chains and bars, sledge hammer/cutting pliers, wedges, sweep-type broom rake, brooms, ¾" bull rope, log roller, first aide kits, hard hats, ear and eye protectors, safety cones, red flagging tape, OSHA approved gas and oil cans.

4. All equipment shall meet the following requirements:

   a. They shall be safe for use in public areas and meet all OSHA standards.

   b. Their operation shall not damage or mar any surface a the Work site.

   c. They shall be operated in a safe manner by trained and qualified personnel.

   d. They shall be clean and in good working order at all times. Remove immediately any piece of defective equipment from the Work site as directed by the Engineer.

   e. All vehicles to be dielectric tested to 100,000 volts to guarantte that vehicles do not conduct electricity.

   f. All upper booms on aerial lifts shall have a fiberglass insert.

5. Aerial Bucket Truck

   The Aerial Bucket Truck shall have a working height of 50'. The following is also required to be included:

   a. One (1) operator.

   b. Two (2) small power saws with 16" bar

   c. One (1) large power saw with a 25" bar

   d. Bull line rope minimum of 300'

   e. Two (2) steel leaf rakes

   f. Two (2) pole saws

   g. One (1) push-type broom

   h. Two (2) coal scoop shovels 16" (short handles)

6. Forestry Truck (Chip Truck)

   The Forestry truck shall be capable of towing a "brush chipper" or "stump cutter" and the "body storage" capacity must be a minimum of seven (7) cublic yards capable of storing chips and debris. Truck must have 6,000-pound chassis. The following equipment is required:

   a. One (1) operator

   b. Two (2) steel leaf rakes

   c. Two (2) shovels

   d. One (1) push broom

   e. One (1) back pack blower

7. Brush Chipper

   The Brush Chipper must be a "heavy-duty commercial" type and must be towable by either a bucket, forestry or powered wagon type vehicle. It should be "diesel" powered and capable of chipping wood up to 12" in diameter.

PART 3. EXECUTION

3.01 PREPARATION

A. Maintenance of Traffic and Work Area Protection

1. No heavy equipment, including trucks, may be used on sidewalk or landscape areas during operations unless approved by the Engineer.

2. Demarcate Work area(s) with roping and traffic cones. Cones shall conform to the requirements of the MUTCD, shall be NCHRP 350 approved and shall be orange rubber or plastic. Cones shall have a maximum weight of 9 kg, including ballast. Standard cones shall be approximately 710 mm in height with a minimum conical bottom width of 250 mm. Standard cones shall have two horizontal circumferential stripes of white reflective sheeting, the upper a minimum of 150 mm wide, with the upper edge 75 to 100 mm from the top of the cone, and the lower a minimum of 100 mm wide with the upper edge approximately 50 mm below the upper stripe. Cones shall bear the Contractor's identification, burned or painted on.

B. Do not begin tree removal operations until the entity performing the Work, the operation and the equipment utilized are approved by the Engineer.

C. Rope off and secure all areas surrounding the trees shown on the Contract Drawings. Provide personnel on the ground to maintain and protect pedestrian and vehicular traffic around the secured area.

D. Tree Removal and Disposal

1. Remove each tree in sections, using either a crane or the block and tackle method, as approved in advance by the Engineer. Exercise care to avoid damage to adjacent structures, landscaping and surfaces.

2. Support with rope and carefully lower to the ground any limbs that might cause damage if dropped from a tree.

3. Cut tree stump flush with the ground surface.

4. Remove tree stump and root ball of each tree removed. Hand excavate as required to avoid damage to underground utilities, if any.

5. Remove and dispose of all debris from tree removal from Authority property in a legal manner.

E. Arborist's Site Inspections/Report

1. Drive/Walk Through Site Inspections

a. During the Contract (prior to rendition of a Certificate of Final Completion), the Contractor's Certified Arborist (NY) and the Contractor shall perform weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer to address the following:

(1) Identify the status/progress of Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's schedule for completion of Work..

b. Within 48 hours of each site inspection, have the Contractor's Certified Arborist (NY) submit a report stating the following:

(1) Site Inspection Attendees.

(2) Agenda and items discussed.

(3) Description of the issues/problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

END OF SECTION

SECTION 02958

TREE REMOVAL AND DISPOSAL (NEW YORK)

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of 'Inspections and Rejections' of Division 1 - General Provisions.

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of the Contractor's membership in the International Society of Arboriculture and State Chapter where they are residing.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications in writing for approval by the Engineer of the Certified Arborist (NY) performing the Work in accordance with 1.03 A.3. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.03 A. Include names of clients, telephone number, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS:

   a. A complete "Products List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.

C. Arborist's Site Inspection Reports

1. Within 48 hours of each site inspection, arrange for the Contractor's Certified Arborist (NY) to submit a 'Site Inspection Report' in accordance with the requirements of 3.01.E.1.

END OF APPENDIX "A"

DIVISION 2

SECTION 02959

TREE REMOVAL AND DISPOSAL (NEW JERSEY)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for tree removal and disposal.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

B. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Road, Suite 101, Londonderry, NH 03053.

1.03 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity and its workers performing the Work of this Section are experienced in tree pruning and removal and have been engaged in work of a complexity similar to that required under this Section for a period of at least three years.

2. Verify that the entity performing Work of this Section is a current member of the International Society of Arboriculture (ISA) and State Chapter where it is located.

3. Verify that the entity performing the work of this Section retains a New Jersey Licensed Tree Expert who possesses a minimum of the following:

   a. Associate's Degree in Horticulture from a recognized college.

   b. A total of five (5) years of work experience.

   c. A current member of the International Society of Arboriculture and State Chapter where they are resideing.

   d. Qualified by the New Jersey Board of Tree Experts during the year(s) this individual is working on this Contract.

e. Quality Assurance.

(1) Qualifications: Ensure that the entity performing the Work of this Contract retains the services of a New Jersey Licensed Tree Expert who shall act as superintendent for tree crown reduction, pruning and removals for all trees for this Contract and shall be on site at all times including but not limited to: scoping out the project with the Engineer prior to any tree work, verifying and supervising tree crown reduction, pruning and removal and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

f. Verify that the entity performing the Work of this Contract owns, at a minimum, the following pieces of equipment:

(1) One (1) Aerial Bucket Truck

(2) One (1) Boom Truck

(3) Two (2) Brush Chippers

(4) Two (2) Forestry Trucks

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be as approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with this specification shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these Specifications.

3. Asian Longhorned Beetle

a. The Contractor shall be aware of the possibility of encountering the Asian Longhorned Beetle: If beetles are observed or suspected of being present, the Contractor shall immediately notify the Engineer and is requested to contact : New Jersey Department of Agriculture, Division of Plant Industry, P.O. Box 330, Room 303, Trenton, NJ 08625-0330, Telephone: (609) 292-5441.

b. If the Contractor is operating in or adjacent to any New Jersey State quarantine area for the Asian Longhorned Beetle, then he shall comply with all State and Federal regulations. Regular updates are provided on: http://www.state.nj.us/agriculture/alblinks.htm

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application, and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products away from Authority property.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

No Work shall proceed prior to receiving written approval of the qualifications of the entity, laborers, certified arborist and evidence of equipment ownership as specified in this Section.

PART 2. PRODUCTS

2.01 MATERIALS

A. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

B. Equipment

1. The Contractor shall provide all necessary equipment and supplies required to perform the work of these Specifications.

2. Equipment shall include but not be limitied to mechanical equipment including aerial bucket trucks, forestry trucks, stump cutters, brush chippers, tree trimmers, log splitters and other similar equipment, and hand equipment including wheel barrows, pruning tools and other similar hand equipment.

3. Equipment shall also include basic skyworker/trim lift tools including but not limited to the following: hydraulic chain saw, manual pole saw (2), lopping shears, gas powered chain saw, hand saw with scabbard (2), ax, gas powered topping saw (2), one-half inch 120 foot long climbing line (2), climbing saddles (2), wheel chucks, extra chainsaw chains and bars, sledge hammer/cutting pliers, wedges, sweep-type broom rake, brooms, ¾" bull rope, log roller, first aide kits, hard hats, ear and eye protectors, safety cones, red flagging tape, OSHA approved gas and oil cans.

4. All equipment shall meet the following requirements:

   a. They shall be safe for use in public areas and meet all OSHA standards.

   b. Their operation shall not damage or mar any surface a the Work site.

   c. They shall be operated in a safe manner by trained and qualified personnel.

   d. They shall be clean and in good working order at all times. Remove immediately any piece of defective equipment from the Work site as directed by the Engineer.

   e. All vehicles to be dielectric tested to 100,000 volts to guarantte that vehicles do not conduct electricity.

   f. All upper booms on aerial lifts shall have a fiberglass insert.

5. Aerial Bucket Truck

The Aerial Bucket Truck shall have a working height of 50'. The following is also required to be included:

a. One (1) operator.

b. Two (2) small power saws with 16" bar

c. One (1) large power saw with a 25" bar

d. Bull line rope minimum of 300'

e. Two (2) steel leaf rakes

f. Two (2) pole saws

g. One (1) push-type broom

h. Two (2) coal scoop shovels 16" (short handles)

6. Forestry Truck (Chip Truck)

The Forestry truck shall be capable of towing a "brush chipper" or "stump cutter" and the "body storage" capacity must be a minimum of seven (7) cublic yards capable of storing chips and debris. Truck must have 6,000-pound chassis. The following equipment is required:

a. One (1) operator

b. Two (2) steel leaf rakes

c. Two (2) shovels

d. One (1) push broom

e. One (1) back pack blower

7. Brush Chipper

The Brush Chipper must be a "heavy-duty commercial" type and must be towable by either a bucket, forestry or powered wagon type vehicle. It should be "diesel" powered and capable of chipping wood up to 12" in diameter.

PART 3. EXECUTION

3.01 PREPARATION

A. Maintenance of Traffic and Work Area Protection

1. No heavy equipment, including trucks, may be used on sidewalk or landscape areas during operations unless approved by the Engineer.

2. Demarcate Work area(s) with roping and traffic cones. Cones shall be reflectorized orange rubber with approximate height, width and wall thickness respectively of 28 inches, 15 inches, 1/8 inch, as manufactured by Western Marking Service, Union City, NJ, or approved equal. Cones shall bear the Contractor's identification, burned or painted on.

B. Do not begin tree removal operations until the entity performing the Work, the operation and the equipment utilized are approved by the Engineer.

C. Rope off and secure all areas surrounding the trees shown on the Contract Drawings. Provide personnel on the ground to maintain and protect pedestrian and vehicular traffic around the secured area.

D. Tree Removal and Disposal

1. Remove each tree in sections, using either a crane or the block and tackle method, as approved in advance by the Engineer. Exercise care to avoid damage to adjacent structures, landscaping and surfaces.

2. Support with rope and carefully lower to the ground any limbs that might cause damage if dropped from a tree.

3. Cut tree stump flush with the ground surface.

4. Remove tree stump and root ball of each tree removed. Hand excavate as required to avoid damage to underground utilities, if any.

5. Remove and dispose of all debris from tree removal from Authority property in a legal manner.

E. Arborist's Site Inspections/Report

1. Drive/Walk Through Site Inspections

a. During the Contract (prior to rendition of a Certificate of Final Completion), the Contractor's Licensed Tree Expert (NJ) and the Contractor shall perform weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer to address the following:

(1) Identify the status/progress of Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's schedule for completion of Work..

b. Within 48 hours of each site inspection, have the Contractor's Licensed Tree Expert (NJ) submit a report stating the following:

(1) Site Inspection Attendees.

(2) Agenda and items discussed.

(3) Description of the issues/problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

END OF SECTION

SECTION 02959

TREE REMOVAL AND DISPOSAL (NEW JERSEY)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

02959D01 Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS: a. A complete "Products List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.
a

Qualifications

02959K01 Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit evidence of the Contractor"s membership in the International Society of Arboriculture and State Chapter where they are residing.

02959K02 Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications in writing for approval by the Engineer of the Licensed Tree Expert (NJ) performing the Work in accordance with 1.03 A.3.. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

02959K03 Within fifteen (15) days of receipt by the Contractor of the acceptance of his proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.03 A. Include names of clients, telephone number, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

Inspection Reports

02959O01 Within 48 hours of each site inspection, arrange for the Contractor's Licensed Tree Expert (NJ) to submit a 'Site Inspection Report' in accordance with the requirements of 3.01.E.1.

END OF APPENDIX "A"

DIVISION 2

SECTION 02960

ADDING COMPOST

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for amending soil with compost prior to seeding and/or landscaping.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Use product testing methods adopted and published by the Association of Official Analytical Chemists, 1111 19th Street Suite 210, Arlington, VA 22209.

B. As a guide to determine local weather predictions, use the National and Local Forecast, Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

C. Use testing methods for 'Assessing Compost Quality' as provided by the Rutgers Soil Testing Laboratory, Rutgers New Jersey Agicultural Experiment Station, New Brunswick, NJ 08901.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the topsoil temperature shall be above 32 degrees F.
2. There shall be no form of precipitation falling or forecast to fall within the next two hours. Following a period of precipitation, resume operations only after the soil has drained.

1.04 QUALITY ASSURANCE

A. Verify that the entity and its workers performing the Work of this Section are experienced in landscaping and have been engaged in work of a complexity similar to that required under this Section for a period of at least three years. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

B. Test Requirements

1. Submit a representative sample of compost material for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01 prior to delivery and at the commencement of each 100 cubic yards of compost delivered to the construction site. No substitutions for testing parameters will be permitted.

2. Take on-site samples only in the presence of the Engineer and at sites ready for operations to commence.

3. Test Soluble salts in Compost utilizing the Saturated Paste Extract method.

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be approved in writing by the Engineer prior to delivery to the construction site.

2. Prior to delivery of compost to the construction site, submit to the Chief of Materials Engineering the following:

   a. The location of the source of compost and the name and address of the supplier.

   b. A certified analysis of the compost that it meets the requirements of this Section. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

   c. A ¼ pound sample.

   d. In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to this Section, all at no additional cost to the Authority.

3. After delivery to the construction site, the Engineer may, at his discretion, take for analysis representative samples of any item listed in PART 2 - PRODUCTS.

4. At the commencement of each 100 cubic yards of compost delivered to the construction site, the Engineer may, at his discretion, take a sample of compost for analysis to determine if the product is in conformance to this Section.

5. In the event that the analysis of the compost sample is not consistent with the requirements specified in 2.01, remove the delivered compost from the construction site and replace it with material that does conform, all at no additional cost to the Authority.

1.05 DELIVERY, STORAGE AND HANDLING

A. Do not deliver bulk compost to the construction site until the Engineer has approved in writing that the product meets requirements of this Section.

B. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

C. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Compost

1. Compost shall be derived from biosolids, free of viable weed seeds and contain material of a generally humus nature. The product shall not contain any materials toxic to plant growth or produce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. Variations in the following specified physical properties are not acceptable. Compost shall conform to the following:

Parameters:	Allowable Range:	Test Method:
Moisture Content		Wet Basis
% water	35% - 60%	
% solids	65% - 40%	
pH	5.7 – 7.7	Saturated Media Extract (SME)
Soluble Salt Level		
SME	<5.0 mmhos/cm (ds/m)	Saturated Media Extract
1:5 dilution	<1.5 mmhos/cm (ds/m)	1:5 dilution
Inorganic Nitrogen		
ppm nitrate-N	50 -200 ppm	SME
ppm ammonium-N	6 – 18 ppm	SME
Organic Matter Content	40% - 60%	
Organic Carbon Content	20% - 25%	
Total Kjeldahl	1.0% - 2.5%	
Carbon-to-Nitrogen Ratio	15 – 30:1	
Maturity Index	6 – 8	Solvita Test

*See Appendix "B" for allowable compost application rates based upon soluble salts levels.

PART 3. EXECUTION

3.01 PREPARATION

A. Areas of Changed Grades

1. Areas of changed grades shown on the Contract Drawings that have a smooth, uniform surface, where compost is to be spread:

   a. Rototill existing soil to a depth of not less than six inches to produce a homogeneous mixture of fine texture, free of clods, stones, roots and other extraneous materials. Remove and dispose of such materials away from Authority property.

   b. Rake and drag soil surface to remove high areas and fill depressions.

   c. Limit preparation to areas that will receive compost immediately following preparation.

2. Areas of changed grades shown on the Contract Drawings that are due to pavement or other material removal which requires adding clean fill and topping with six-inches of screened loam soil and adding 2-inches of compost:

   a. Rototill clean fill to a depth of not less than six inches to produce a homogeneous mixture of fine texture, free of clods, stones, roots and other extraneous materials. Remove and dispose of such materials away from Authority property.

   b. Rake and drag to remove high areas and fill depressions.

   c. Limit preparation to areas that will receive compost immediately after preparation.

B. Unaltered Areas

Prepare areas shown on the Contract Drawings as unaltered or undisturbed by excavation, grading or stripping operations as follows:

1. Remove existing vegetation and turf. Dispose of vegetative matter away from Authority property.

2. Rototill to a depth of not less than six inches to produce a homogeneous mixture of fine texture, free of clods, stones, roots and other extraneous materials. Remove and dispose of such materials away from Authority property.

3. Rake and drag to remove high areas and fill depressions.

4. Limit preparation to areas that will receive compost immediately after preparation.

C. Sustainable Measures

Remove all debris resulting from the soil preparation operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer. Remove and transport off Authority property all debris materials resulting from the soil preparation operation in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".

3.02 INSTALLATION

A. Formulation, Application, and Equipment - General

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products away from Authority property.

B. Apply a minimum of 2" of compost evenly over area and uniformly incorporate (rototill) into the soil to a minimum depth of six inches.

C. Commence seeding and/or landscaping applications immediately after incorporating compost.

END OF SECTION

SECTION 02960

ADDING COMPOST

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of 'Inspections and Rejections' of Division 1 - General Provisions.

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - GENERAL PROVISIONS:

   a. A complete "Products List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.

   b. Material Data Safety Sheets for all toxic or hazardous materials to be used under this Section.

2. Submit the location of the source of the compost, a 1/4-pound representative sample of compost (as many as required) and test results to the Chief of Materials Engineering.

C. Test Reports

Submit laboratory analyses of the compost to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance with 2.01 B.

END OF APPENDIX "A"

SECTION 02960

ADDING COMPOST

APPENDIX "B"

COMPOST – SOLUBLE SALTS LEVELS

Use the following table to determine the maximum allowable ECe(dS/m of saturation extract) of compost at the desired application rate:

Desired Use Rate		Salinity (ECe) of On-Site Soil		
Cubic Yards Amendment per 1000 Sq. Ft. for incorporation to 6" depth	Volume Percentage of Amendment	3 dS/m	2 dS/m	1 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9.5	14
4	22	3.5	7	10.5
5	27	3	5.5	8.5
6	32	2.5	4.5	7

Example: If Specification calls for 6 cubic yards compost per 1000/sq. ft. to be incorporated into the top 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding an ECe of 4 in the final blend, compost ECe should be less than 4.5 dS/m.

END OF APPENDIX "B"

DIVISION 2

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for maintenance of permanent planting and hardscape, prior to rendition of the Certificate of Final Completion.

B. Maintain plantings and hardscape listed in Item A of Appendix "D" in this Section that are within the "Areas of Work" shown on the Contract Drawings.

C. Perform functions as scheduled and described in Item B of Appendix "D" in this Section.

D. "Maintenance of Permanent Planting", "Maintenance of Landscaping", or "Landscaping Maintenance", or words of similar import, shall mean all the functions specified in Appendix "D" to this Section.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Perform maintenance operations using materials and methods in accordance with this Specification and Contract Drawings.

B. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

C. To determine caliper, size, height, width and root spread of plants, use the "American Standard for Nursery Stock" ANSI Z 60.1-2004, published by the American Nursery & Landscape Association, 1000 Vermont Ave., NW, Suite 300, Washington, D.C. 20005.

D. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Road, Suite 101, Londonderry, NH 03053.

E. As a guide to determine local weather predictions use the National and Local Forecast Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

F. Mulch shall conform to current standards established by Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 20111-4245.

G. Perform replacement of items listed in Item A of Appendix "D" to this Section only during the appropriate growth season of the particular item. Provide plants of quality, size, genus, species and variety to match original installation(s).

1. Replace trees and shrubs that are defective due to death, defoliation, disfigurement, infestation and off-color foliage.

2. Repair or replace lawn or ground cover areas due to erosion, bare or sparse growth, or weed or pest infestation.

H. In the case of loss or damage due to unusual phenomena or incidents, commence clean up within 48 hours of such loss or damage or notification of such loss or damage, and complete such Work within the scheduled time(s) as approved and directed by the Engineer.

I. Replacement plants furnished by the Contractor shall be subject to warranty for the same time period as the original installations.

J. Pest control for plants shall be in accordance with the "2006 Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs", published by Cornell University, Ithaca, NY. This publication is available from The Resource Center, Cornell University, Ithaca, NY 14853. Telephone (607) 255-9946.

K. Maintain the automatic irrigation system as per Appendix 'D' of this Section to deliver required amounts of water to plantings as per 3.03 B and 3.03 K., 4. of this Section.

L. All materials, activities and procedures shall be in accordance with the Federal Aviation Administration (FAA) – Advisory Circular No. 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports", August 28, 2007.

L. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, Current Edition, Northeastern Regional Publication No. 493 as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland; Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the soil and backfill materials temperature at each planting area shall be above 32 degrees F.

2. Perform planting and soil related operations only when no form of precipitation is falling or forecasted to fall within the next 2 hours. Following a period of precipitation, resume operations only after the soil has drained.

B. Planting Calendar Limitations

Planting shall be performed only during the following periods:

1. Deciduous Plants: March 1 - May 1 and October 15 - December 1

2. Evergreen Plants: April 1 – May 15 and September 1 – October 15

3. Herbaceous Species April 1 – June 1 and August 15 – September 30

4. Seeding – as per Section 02930 Appendix B.

C. Apply chemicals only when wind velocity does not exceed 5 mph, drift hazard is negligible, the air temperature is above 40 degrees Fahrenheit and below 70 degrees Fahrenheit, no precipitation has fallen within 2 hours prior to application, and no precipitation is forecasted for the 12 hour period after application.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Verify that the entity performing the Work of this Section shall employ workers experienced in landscaping and landscape maintenance and shall have engaged in Work similar to the requirements of this Section for a period of at least 5 years.

2. Verify that the entity performing pesticide applications is licensed as a commercial applicator by the state in which the Work is being performed.

3. Verify that the entity supervising the pruning, planting and maintenance of this Section is a current member of the International Society of Arboriculture (ISA) and State Chapter where it is located and a ISA Certified Arborist (NY).

4. Verify that the entity performing the Work of this Section shall have a ISA Certified Arborist (NY) available within (24) twenty-four hours upon request.

   a. Verify that the entity performing the Work of this Contract shall have a ISA Certified Arborist (NY)on staff who possesses a minimum of the following:

      (1) Associates Degree in Horticulture from a recognized college.

      (2) A total of five (5) years of work experience.

      (3) A member of the International Society of Arboriculture and State Chapter where they are residing.

      (4) Qualified by International Society of Arboriculture during the year(s) this individual is working on this Contract.

   b. Quality Assurance

      (1) Qualifications: Verify that the entity performing the Work of this Contract utilizes the services of a ISA Certified Arborist (NY) who acts as superintendent for the installation and all maintenance of plantings for this Contract and shall be on site at all times including but not limited to: inspects replacement trees at the Nursery where they are grown, plant material (tree) deliveries, maintenance of plants at the site after delivery and prior to installation, verifying the root flare on all trees prior to planting, guying and staking of trees, mulching, pest management, , application of bio-stimulants to all plant materials, and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings. Transmit from the ISA Certified Arborist (NY) to the Engineer information of any discrepancies or non-compliance to the Contract Specifications and Drawing.

5. Verify that the laboratory performing the laboratory testing of this Section shall be a certified testing laboratory such as the Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850,or an approved equal in either the State of New Jersey or New York and shall have experience in soil testing for soil properties important for plant and turf management and shall perform all tests as specified in 2.01 A, 2.01 B and as outlined in Appendix B and Appendix C of this Section.

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to a the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with this Specification shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with this Specification.

3. Obtain, retain, and make available for on-site inspection at all times, U.S. Department of Labor, Material Safety Data Sheets for all toxic substances and hazardous materials to be used in this Contract. Give one copy of said sheets to the Engineer for review and approval prior to introduction of material to the construction site.

4. All plant materials shall be grown in nurseries located within the following states: Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

5. All plant material shall be 'Nursery Grown.' Nursery Grown shall mean that the fields, where the plants are to be obtained, are from active and working nurseries where the following horticultural practices have been aggressively performed:

   a. IPM Program - Integrated Pest Management Program

   b. Cultivation - Including weed suppression

   c. Fertilization

   d. Pruning

   e. Irrigation

   Any plant material from a field where the above horticultural practices have not been consistently practiced in the last twelve (12) months shall be rejected.

6. Pesticide

   a. Select to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.

   b. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate at the construction site only in a work area designated by the Engineer.

   c. Keep all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within 5 days when so requested.

d. Not less than forty-eight hours prior to a proposed spray operation, submit to the Engineer for his approval, a tabulated list indicating the target to be treated, the chemical trade name and quantity of mix being prepared.

e. All pesticide/herbicide applications shall be subject to inspections by the Engineer. The Engineer may at any time, suspend and reschedule a pesticide/herbicide application when, in his determination, the weather conditions are unfavorable, facility operations would be hampered or the Contractor's methods or materials fail to comply with this Specification.

7. Asian Longhorned Beetle

The Contractor shall be aware of the possibility of encountering the Asian longhorned beetle. If beetles are observed or suspected of being present, the Contractor shall immediately notify the Engineer and is requested to contact: New York State Department of Agriculture & Markets at (800) 554-4501 extension 72087, or the ALB hotline at (877) STOPALB (877-786-7252). (Division of Plant Industry, Kevin S King, Director (518)457-2087) and the Staten Island Borough Forestry Office at NYC Parks & Recreation Attn: FORESTRY 1150 Clove Rd. Staten Is., NY10301, Fax: (718) 816-9194, Ph: (718) 390-2080.

C. Specific Requirements for Operations and Products

1. Plants

a. Coordinate all arrangements and accompany the Engineer on all inspections of plants at the nursery. Provide a minimum of 48 hours prior notice to the Engineer. Do not dig or remove any plant prior to inspection by the Engineer.

b. All plants inspected by the Engineer at the nursery will be sealed with Authority seals, or at the discretion of the Engineer, typical representative numbers of such plants may be sealed.

c. Deliver to the construction site plants which were sealed and whose seal numbers conform to the Engineer's nursery inspection records.

d. Unsealed plants that, in the sole opinion of the Engineer, are not equal in quality to the sealed samples will be rejected.

e. Each shipment shall be certified by Federal and State authorities to be free of insects and diseases. Inspection certificates to this effect that would be required by law, if the Authority were a private corporation, shall accompany each shipment invoice and shall be delivered to the Engineer.

f. All plants, sealed or unsealed, shall be subject to tailgate inspection upon arrival at the construction site. All plants failing to meet the requirements of this Section will be rejected by the Engineer. Such rejected plants shall be removed from Authority property and replaced at no additional cost to the Authority.

g. At the discretion of the Engineer, typical representative numbers of plants may be removed from their growing containers for inspection.

2. Drive/Walk Through Site Inspections

a. During the installation and maintenance period, the Contractor's ISA Certified Arborist (NY) and the Contractor shall perform bi-weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer, to address the following:

(1) Identifying the status of the Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's work.

b. Within 48 hours of each site inspection, the Contractor's ISA Certified Arborist (NY) shall submit a report stating the following:

(1) List site inspection attendees.

(2) Agenda and item(s) discussed.

(3) Description of the issues or problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

3. Screened Loam Soil

a. Prior to delivery to the construction site, submit a representative sample of screened loam soil for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01 A. No substitution for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 A and Appendix B of this Section.

b. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

c. Prior to delivery to the construction site, the Contractor shall submit to the Chief of Materials Engineering the following:

1.) The location of the source of the screened loam soil.

2.) A certified analysis of the loam soil that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation".

4.) A two pound sample for each 100 CY of screened loam soil delivered to the construction site..

5.) In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

d. Do not deliver screened loam soil to the construction site until the Engineer of Materials has approved the submittal in writing.

e. After delivery of screened loam soil to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 A. Submit test results to the Chief of Materials Engineering for approval for up to each 100 Cubic Yards of screened loam soil delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened loam soil from the construction site and replace it with material that does conform, at not cost to the Authority.

4. Planting Mix

a. Do not combine planting mix components until all components have been approved in writing by the Chief of Materials Engineering.

b. After mixing operations have been completed and prior to delivery of planting mix to the construction site, submit a representative sample of the planting mix to a certified independent laboratory to ensure conformance to requirements specified in 2.01 B. No substitutions for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 B and Appendix C of this Section.

c. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

d. Prior to delivery to the construction site, submit to the Chief of Materials Engineering the following:

1.) The location of the source of the planting mix and the name and address of the supplier.

2.) A certified analysis of the planting mix that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation"for the crop identified as ornamental plants.

4.) A two pound sample.

5.) In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

6.) A letter certifying that the source components and their suppliers, or the planting mix are all as approved by the Chief of Material Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.

e. Do not deliver planting mix to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

f. After delivery of the planting mix to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 B. Submit test results to the Chief of Materials Engineering for approval for each 100 Cubic Yards of planting mix delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered planting mix from the construction site and replace it with material that does conform, all at no cost to the Authority.

5. Compost

a. Prior to delivery of compost to the construction site, submit to the Chief of Materials Engineering the following:

1). The location of the source of compost and the name and address of the supplier.

2). A certified analysis of the compost that it meets the specifications herein. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

3). A ¼ pound sample.

4). In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

6. Lawn Mower Equipment

a. Verify that the entity performing lawn mowing utilizes a Mulching Mower, capable of producing a fine mulch and produce no windrows. Provide a list of lawns mowers to be used as well as the manufacturer catalog cuts describing how the mulching mower operates to produce a fine mulch and produce no windrows.

D. Certification

1. Verify that the concentration of environmental parameters in all soil mixes shall not exceed the NYSDEC's Soil Cleanup Criteria as stated in NYSDEC CP-51.

2. A letter certifying that the source components and their suppliers for the planting mix are all as approved by the Chief of Materials Engineering and that no substitutions have been made to the source components and their suppliers without the approval of the Engineer.

E. Replacement

1. Replace unsatisfactory furnished and installed plants which, in the sole opinion of the Engineer, die or otherwise become unsatisfactory.

2. Replace unsatisfactory plants with products and by operations that comply with all requirements of these Specifications, and on such date(s) as ordered by the Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products in a legal manner.

D. Specific Requirements

1. Screened Loam Soil, Planting Mix and Compost

Conform to requirements of 1.04 C.3, 1.04 C.4 and 1.04 C.5.

2. Plants

Conform to requirements of 1.04 C.1 and as follows:

a. Transport plants in covered trucks only. Plants transported on open trucks from the nursery will be rejected by the Engineer.

b. Handle balled and burlapped trees using the method shown on the Contract Drawings.

c. Carry plants by the ball or container and not by stems.

d. Do not drop plants.

e. Protect all delivered plants from drying out by providing shade and water. Do not allow plants to become dry or wilted.

f. After plants have been set on the ground, apply water as needed, and cover balls with plastic sheeting.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Screened Loam Soil

Fertile, friable, natural loam soil, free of subsoil, supplier-certified as having been obtained from an area which has never been treated with herbicide and conforming to the following:

1. Screened loam soil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods; partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass or any other undesirable material.

2. Screened loam soil shall contain a minimum of 5 percent organic matter and maximum of 8 percent organic matter as determined by loss of ignition of moisture-free samples.

3. pH range shall be 5.0 to 7.0, inclusive.

4. The range of soluble salts shall be equal to or less than 500 micromhos per centimeter.

5. Screened loam soil shall be graded as follows:

Passing	Retained On	Percentage
1" screen		100%
1" screen	2mm (No.10) Sieve	Not more than 40%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

6. The portion of screened loam soil passing the 2mm sieve, based on the mechanical analysis of the soil as determined by the Buoyoucous Hydrometer method, shall consist of the following based on dry weight of sample:

a. Sand 40%-60%, inclusive

b. Silt 30%-40%, inclusive

c. Clay 10%-30%, inclusive

B. Planting Mix

Composed of screened loam soil, various soil amendments and nutrient control materials conforming to the following:

1. Planting mix shall contain a minimum of 7% and a maximum of 15% organic matter as determined by loss on ignition of moisture free samples, and the pH range of 5.0 to 7.0, inclusive, with 60% passing a 1" screen.
2. The range of soluble salts shall be equal to or less than 1250 micromhos per centimeter.
3. Each 5 cubic yards of planting mix shall contain:
   a. 3 3/4 cubic yards of screened loam soil;
   b. 1 1/4 cubic yards of compost
   c. 17 lbs. of Hydrogel
4. Planting mix shall be loose, friable and not frozen or saturated at the time of mixing.

C. Compost

1. Compost shall be derived from biosolids, free of viable weed seeds and contain material of a generally humus nature. The product shall not contain any materials toxic to plant growth or produce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. Variations in the following specified physical properties are not acceptable. Compost shall conform to the following: .

Parameters:	Range:
pH	5.7 – 7.7
Moisture Content	35% - 55%
C: N Ratio	15 – 30:1
Organic Matter	40% - 50%
*Soluble Salts – Saturated Paste Method	< 5.0 mmhos/cm (ds/m)
Nitrogen	> 1.5%
Phosphorus	< 20%
Potassium	< 0.5%
Maturity Index	7-8

*See Appendix "E" for allowable compost application rates based upon soluble salts levels.

D. Weed Control

1. Pre-emergent Herbicide

"Treflan 5G" as manufactured by Elanco Products Co., Indianapolis, IN 46285 or approved equal.

2. Post-emergent Herbicide/Glyphosate.

a. "Roundup Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

41% - Glyphosate N - (phosphonomethyl) glycine

59% - Inert Ingredients

b. "Rodeo" as manufactured by Dow AgroSciences, Indianapolis, IN 46268 or approved equal conforming to the following:

53.8% - Glyphosate N – (phosphonomethyl) glycine

46.2% - Inert Ingredients

E. Hydrogel

1. "Viterra Gelscape" as manufactured by Amereq, Inc., New City, NY 10956.
2. "Super Sorb" as manufactured by Aquatrols Corps of America, Inc., Cherry Hill, NJ 08003.
3. "Soil Moist" as manufactured by JRM Chemical Inc., Cleveland OH 44125
4. "AquaGel A, B, C, D" as manufactured by Profile Products, Buffalo Grove, IL 60089
5. Or approved equal.

F. Nursery Stock

1. Furnish plants in the quantity, species, and meeting the size, height and width requirements as shown on the Contract Drawings.
2. Furnished plants shall conform to the following:
   a. Measure plant size as it stands in its natural position.
   b. Conform to plant sizes, heights and widths as shown on Contract Drawings.
   c. For container grown plants, if used, conform to the dimensions for height, width, number of canes and container size as shown on the Contract Drawings.
   d. Plants furnished shall be an average of the minimum and maximum sizes shown on the Contract Drawings.
   e. Do not use large plants cut back to sizes specified.
   f. Plants shall be sound, healthy, vigorous growing specimens.
   g. Plants shall exhibit uniform growth and a form characteristic of their species.
   h. With respect to their canes, trunks, stems, and branches, shrubs shall:
      (1) Have normal, well-developed canes and branches.

(2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sunscald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, damage due to machinery operation, improper pruning and blasted buds.

i. Plants' foliage shall be free from chlorosis, yellowing, blemishes or damaged parts.

j. Plants shall have vigorous, fibrous root systems.

k. Container grown plants, if used, shall have been grown in the container long enough to develop new fibrous roots so that the root mass will retain its shape and hold together when removed from the container. Recently potted or root-bound plants will not be accepted by the Engineer. Container-grown plants shall be free from girdling roots.

l. With respect to their trunks and branches, trees shall:

(a.) Have normal, well-developed branches.

(b.) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sunscald injuries, abrasions of the bark, girdled trunk or branches, malformed head due to overcrowding within nursery fields, damage due to machinery operation, improper pruning and blasted buds.

(c.) Have straight trunks with a sturdy central leader. Clump form trees may have more than one straight leader. Lateral branches shall arise near right angles forming a U-shaped crotch. Trees with V-shaped crotches will be rejected by the Engineer.

(d.) Have been properly pruned to ensure a strong, sturdy, symmetrically shaped canopy.

(e) Root flare exposed and no more than two inches of native soil or container soil found to be above the tree or shrubs natural root flare at the trunk.

(f) Whenever, the root flare is not exposed, an airspade shall be employed to expose the natural root flare. The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority. Airspading or other methods employed to remove soil from above the natural root flare shall be performed in the presence of the Contractor's ISA Certified Arborist (NY).

m. With respect to their roots, trees shall:

(1) Be free from girdling roots.

(2) If girdling roots are present, have the Contractor's ISA Certified Arborist (NY) remove them at no cost to the Authority.

(3) If it is determined that the girdling root cannot be satisfactorily removed by the Contractor's ISA Certified Arborist (NY), then remove the affected tree immediately and replace it with a tree that meets this specification, at no additional cost to the Authority.

(4) Bareroot plants shall be prohibited.

3. Instructions for digging and balling plants are as follows:

a. Dig immediately before moving.

b. Dig to retain as many fibrous roots as possible.

c. Do not use loose, broken or manufactured balls.

d. Wrap and tie balled and burlapped plants with untreated burlap and sisal or jute twine. Do not ball and tie with treated (or "no rot") material.

e. Trees – Trunk Flare

(1) Trees shall have all excess soil removed from the top of the true root ball and full exposure of the trunk flare, prior to ball and burlap operations at the Nursery.

(2) The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

(3) Trees delivered to the construction site with 2" depth (or greater) of excess soil on top of the true root ball and unexposed trunk flare will be rejected by the Engineer.

G. Soil pH Adjustment

1. – Elemental Sulfur

Guaranteed analysis shall be:

0% Nitrogen

0% Phosphorus

0% Potassium

90% Sulfur

2. Granulated Dolomotic Limestone

As manufactured by Limecrest, Sparta, NJ 07871, or approved equal conforming to the following:

a. Total carbonates not less than 86% of 48.2% calcium oxide equivalent. For purposes of calculation, total carbonates shall be considered as calcium oxide. Magnesium oxide content shall be between 15-22%.

b. A dust-free, homogenous, granular material.

H. Bio-Stimulants

1. Bio-Stimulant shall be a dry, water soluble root growth stimulant with nitrogen-fixing, phosphorus solubilizing and growth promoting bacteria packaged in ¼ pound (114 grams), pre-measured packs conforming to the following:

Ingredients:	% by Weight
Humates and Humic Acid	40%
Cold Water Sea Kelp Extract	35%
Essential Amino Acids (18)	7%
Sucrose and other Natural Sugars	6%
Citric Acid	5%
Vitamins and Growth Factors	2% (including B1, B2, B6, B12, Biotin, Folic Acid, Niacin and Vitamin K)
Nitrogen Fixing Bacteria	Approx. 60 Billion per Pound
Phosphorus Solubilizing Bacteria	Approx. 60 Billion per Pound
Growth Promoting Bacteria	Approx. 60 Billion per Pound
12% Potassium (K2O) derived from Humate and Kelp Extracts	

2. Bio-Stimulant shall bw "PHC BioPak Water Soluble Powder" as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, or an approved equal.

I. Rodent Control

1. Rodent Control shall be a water soluble, non-toxic, colorless solution with the following active ingredients:

Ingredient:	Percentage:
Benzyldiethyl (2.6 xylycarbamoyl) Methyl, Ammonium Saccharide	0.065%
Thymol	0.035%
Inert Ingredients	99.9%

2. Rodent Control shall be "RO-PEL" as manufactured by Burlington Bio-Medical & Scientific Corp., Farmingdale, NY 11735-1527 or an approved equal.

J. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

K. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

L. Tree Staples

1. Tree Staples shall be uncoated, cold-rolled, plain carbon steel 'Tree Staples' as manufactured by Tree Staple Inc., New Providence, New Jersey, 07974. Tree Staples are protected under U.S. Patent No's. 6, 141, 903, & 6,065,243.
2. Tree Staple sizes as shown on the Contract Drawings.
3. Tree Staples are available from the following suppliers:
   a.) NYP Corp., 805 East Grand Street, Elizabeth, New Jersey, 07201.
   b.) Northern Nurseries, 487 Elizabeth Avenue, Somerset, New Jersey, 08873.
   c.) Northeastern Supply, 50 Notch Road, West Paterson, New Jersey, 07836.
   d.) Or approved equal.

R. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:
   a. Constructed of ultra-violet light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.
   b. Each TreeGator bag to have a 20 gallon water capacity and weigh 1 ½ pounds empty.
2. TreeGator Junior portable drip irrigation system shall conform to the followng:
   c. Constructed of PVC with reinforced heat-sealed seams and removable vinyl emitter-system, which shall consist of a PVC-L Valve and a PVC Emitter Insert.
   d. Each TreeGator Junior to have a 14 gallon water capacity
3. TreeGator portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187

PART 3. EXECUTION

3.01 PREPARATION

A. Maintenance of Traffic and Work Area Protection

1. No heavy equipment, including trucks, may be used on paved pedestrian or sidewalk areas during maintenance operations unless approved by the Engineer.
2. Demarcate Work area(s) with roping and traffic cones. Cones shall be reflectorized orange rubber with approximate height, width and wall thickness respectively of 28 inches, 15 inches, 1/8 inch, as manufactured by Western Marketing Service, Union City, NJ, or approved equal. Cones shall bear the Contractor's identification, burned or painted on.

B. For pesticide preparation, conform to1.04 B.6 and 3.02 E of this Section.

C. For pruning, conform to 3.02 F of this Section.

D. For tree removal, conform to 3.02 H of this Section.

3.02 ADJUSTMENTS

A. Perform maintenance operations in accordance with Item B of Appendix "D" to this Section.

B. Irrigation

1. Trees and Shrubs

   Frequency will vary depending on environmental factors. The total amount of water, from natural or applied irrigation shall be not less than one inch per week as per Appendix "D".

2. Herbaceous Species

   During periods of irrigation, add a minimum of ½ of an inch of water during any one irrigation period and up to three inches per week.

C. Sanitation

1. Weeding

   a. Manually remove before growth and maintain all permanent planting areas and hardscape areas "weed-free" at all times.

   b. Identify weeds and apply selective pre-emergent and post-emergent herbicides according to Part 3.03 E of this Section for both landscape and hardscape areas.

2. Litter Removal

   Maintain plantingsand paved areas located within the "area of work" shown on the Contract Drawings free of litter or debris of any type.

D. Mowing of Lawn Areas

1. Maintain a maximum height of 2 1/2 inches.
2. Trim edges.
3. Remove clippings after mowing and trimming.
4. Broom clean clippings from adjacent paved areas.

E. Pest Control

Shall include but not be limited to managing insect, weeds and disease pests using the Integrated Pest Management (IPM) concept, the identification of pests, monitoring pest activity and population, the submittal of a pest control program and the proper application of pesticides, avoiding injury to non-target organisms and the environment, and as follows:

1. Notify the Engineer of infested plants.

2. Apply specific pesticides in accordance with Appendix "D".

3. Identify plant pests in their early stage of development and within 48 hours of identifying a pest on any plant, proceed as follows:

   a. Specify the number of plants or planted areas requiring treatment, and their locations.

   b. Submit written pesticide program in accordance with 1.04 B.6 of this Section.

   c. Failure to notify the Engineer prior to severe infestation shall mean the Contractor accepts full responsibility for the health of permanent planting including replacement In-Kind with a pest-free and disease-free plant.

4. During Pesticide Application Operations the following shall apply:

   a. Applicators shall be properly licensed in accordance with 1.04 A.2 and attired with protective clothing, gloves and other required equipment.

   b. Equipment shall be clean, safe, leak-free and in good working order. Remove malfunctioning equipment from the work site.

   c. Secure the area from pedestrian traffic by roping off the area and place signs as directed by the Engineer.

   d. Provide workers to supervise the operation and to keep pedestrians from approaching within 50 feet of area.

   e. Protect all areas from spills and immediately report spills to the Engineer.

F. Pruning

1. Prune all plants in order to maintain healthy compact growth.

2. Prune in accordance with the Tree Care Industry Association's ANSI A300 "Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices" and in accordance with Appendix "D" and as follows:

   a. Provide and maintain a traffic cone and rope barricade around all work areas during pruning operations.

   b. Provide a worker on the ground to redirect pedestrian traffic during tree pruning operations.

   c. Perform pruning with sharp tools. Disinfect tools by dipping in alcohol at the commencement of the day's operation and again after finishing each plant known to be diseased. Use fresh alcohol each day for this operation.

   d. Prune to remove dead, weak, interfering, suckered, damaged or unsightly twigs or branches.

3. Prune to maintain the species' characteristic shape.

4. In addition, prune shrubs and herbaceous species and deadhead flowers to control and renew growth and prolong flowering in accordance with Appendix "D".

5. No tree climbing permitted. For trees less than 15 feet in height, use free standing ladders and do not touch the tree trunk.

6. Do not disturb utility lines during pruning operations.

7. Do not use anvil-type, pruning tools.

8. Make pruning cuts at the branch collar. Crushed, jagged cuts or cuts leaving too much stub and existing improper cuts are to be properly re-cut.

9. Carefully clean and shape large wounds.

G. Winter Protection

Protect plantings in accordance with Appendix "D" and as follows:

1. Apply anti-desiccant with a power sprayer to provide adequate protective film over trunks, branches, twigs and/or foliage.

H. Tree and Shrub Removals

1. Within 24 hours of notification by the Engineer, remove, at the Contractor's expense, all plants that are dead or otherwise become unsatisfactory as directed by the Engineer. However, if it can be proven to the Engineer, that the plant's death was not due to neglect or abuse caused by the Contractor, the Contractor will not be responsible for cost of such replacement.

2. Prior to commencing removal operation, obtain the Engineer's approval of proposed removal methods and equipment.

   a. Rope all areas surrounding the trees being worked on and provide a ground person to direct pedestrian traffic.

   b. Remove the tree stump and root ball completely.

   c. Manually remove all shrubs.

   d. Remove and dispose of all debris away from Authority property.

I. Tree Staple Maintenance

1. In accordance with Appendix 'D' or as directed by the Engineer, monitor the integrity of all tree staples installed under this Contract. Re-spike and adjust tree staples that have been heaved by frost and verify the structural condition of all tree staples installed under this Contract.

2. In instances where the tree roots may be girdled by tree staples, verify these conditions in the presence of the Contractor's and Authority's New York Certified Arborist and if required, remove tree staples as directed by the Contractor's New York Certified Arborist and the Engineer.

3. In accordance with Appendix "D" or as directed by the Engineer, remove and dispose of tree staples away from Authority property.

J. Mulching

1. Maintain shredded hardwood bark mulch to a maximum depth of two (2) inches at all times. Adjust mulch layer in accordance with Appendix "D", the Contract Drawings, and as directed by the Engineer.

2. Maintain a minimum radius of 4 inches between the tree or shrub trunk flare and the start of the mulch.

3. Mulch Volcanoes shall be prohibited. Wherever mulch is inappropriately applied, the Contractor shall remove the inappropriately installed mulch from the construction site and replace it in conformance with the Contract Drawings at no cost to the Authority.

K. Arborist's Site Inspections/Reports

1. Drive/Walk Through Site Inspections

a. During the Contract (prior to rendition of a Certificate of Final Completion), the Contractor's ISA Certified Arborist (NY) and the Contractor shall perform bi-weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer to address the following:

(1) Identify the status/progress of Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's schedule for completion of Work..

b. Within 48 hours of each site inspection, the Contractor's ISA Certified Arborist (NY) shall submit a report stating the following:

(4) Site Inspection Attendees.

(5) Agenda and items discussed.

(6) Description of the issues/problems.

(7) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

L. Rodent Control Applications

1. Apply a minimum of two (2) rodent control applications per year, between November 1st and December 15th, as per the manufacturer's directions and in accordance with Appendix 'D'.

2. Rodent control shall be applied in the presence of the Engineer.

M. Precast Concrete Block Pavement

Maintain the Precast Concrete Block Pavement shown on the Contract Drawings free of weeds, litter, debris and any other deleterious materials and in accordance with Appendix 'D'.

END OF SECTION

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - General Provisions:

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the Testing laboratory performing the work of this Section.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit evidence of the entity's membership in the International Society of Arboriculture and State Chapter where they are residing.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications in writing for approval by the Engineer of the ISA Certified Arborist (NY) performing the Work in accordance with 1.04 A.4. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

4. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section, and evidence of license of pesticide applicator.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit the following:

   a. A complete "Product List", listing all products to be used under this Section including: Product name, manufacturer, catalog cuts, details, samples, manufacturer's specifications and certified test data/analysis of each product.

   b. Material Data Safety Sheets for all toxic or hazardous materials to be used under this Section.

   c. A complete "Plant List", listing all greenhouse and nursery sources for all trees, shrubs and herbaceous species..

2. Submit the location of the source of the screened loam soil, planting mix , and compost and a two-pound representative sample of screened loam soil, planting mix and compost (as many as required) to the Chief of Materials Engineering in accordance with 1.04 C.3., 1.04 C.4. and 1.04 C.5.

C. Test Reports

Submit laboratory analyses of screened loam soil and planting mix and the results of the "Landscape Level 3 Topsoil Evaluation" to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 1.04 C.3, 1.04 C.4, Appendix B and Appendix C.

D. Maintenance Reports

1. Once a month, submit to the Engineer an inventory of dead plants to be replaced. Replacement of planting shall follow the same procedures set forth in the Specification Sections 02940, 02971 (herein) and the Contract Drawings.
2. Prior to completion of all work, submit to the Engineer an inventory of pesticides used and pests identified in all the Areas of Work.

E. Certified Tree Expert's Inspection Reports

1. Within 48 hours of each site inspection, the Contractor's ISA Certified Arborist (NY) shall submit to the Engineer an inspection report, to include but not be limited to the following: List of inspection attendees, the item(s) discussed, a brief description of maintenance issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

F. Certifications

1. Submit plant inspection certificates, in accordance with requirements of 1.04 C.1.e.
2. Submit to the Chief of Materials Engineering, certification required by 1.04 D.

G. Notification

1. Pesticide application information, in accordance with 3.02 E of this Section.

END OF APPENDIX "A"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

APPENDIX "B"

Material: Screened Loam Soil

Specification: Section 02921 – Screened Loam Soil

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 5% Max. 8%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 500 Max. 300		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 30%		

END OF APPENDIX "B"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

APPENDIX "C"

Material: Planting Mix

Specification: Sections 02940 – Trees, Shrubs and Ground Cover (New York)

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 7% Max. 15%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 1250 Max. 750		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones		
Passing 2mm (#10) **Retain Pan**	Min.60.0%		
Buoyoucous Hydrometer **Test of Material:**			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 30%		
Potassium: lbs./Acre			
Phosphorus: lbs./Acre			
Nitrogen From NO3: lbs./Acre			
Nitrogen From NH4: lbs./Acre			

END OF APPENDIX "C"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

APPENDIX "D"

A. To Be Maintained

Trees
Shrubs

Herbaceous Species

Lawn Areas within the Limit of Construction Area

Precast Concrete Block Paver Salt Splash (material installed in this Contract)

B. Maintenance To Be Performed

Function	Schedule	Description
Irrigation- (Manual & Tree Gator Bags)	April, May, Oct. & Nov. June, July, Aug. & Sept.	Water once per week. Water twice per week.
Mowing	May, June, July, Aug. & Sept.	Once a week
	Apr., Oct. & Nov.	Once every 2 weeks
Weed Removal	April – November	Identify/remove once/week
Litter Removal	January - December	Once a week
Fallen Leaf Removal	October - December	Once a week until trees are defoliated. Rake/remove from work site.
Dead Plants/Parts Removal	May - November	Once/week; remove dead plants/branches/flowers
	June 15 – November 15	Submit an inventory of plants to be replaced during the next planting season.
Pre-Emergent Herbicide – Shrubs	April 1 - April 30	One application (Treflan 5G)
Pre-Emergent Herbicide – Hardscape Non-Landscaped Areas	April 1 - April 30	One application (Treflan)

Function	Schedule	Description
Post-Emergent Herbicide – Hardscape Non-Landscaped Areas	June - September	As needed (Glyphosate)
Pesticides – Trees	Immediately prior to budbreak	One application of dormant oil
Pesticides – Trees, Shrubs & Ground Cover	April - September	Check once/month; if infested, identify pest(s) and treat.
	November 15	Submit an inventory of pesticides used and pests identified based upon the current season's findings.

Function	Schedule	Description
Nutrient Control – Trees, Shrubs, Groundcover and Herbaceous Species		
Bio-Stimulant Applications:		Two Applications per Year as follows:
For Fall Planting Completion Date:	April 1 – April 15	One Application
For Spring Planting Completion Date:	September 1 – September 15	One Application
	September 1 – September 15	One Application
Rodent Control – All Plantings	April 1 – April 15	One Application
	November 1 – November 15	One Application to all plants
Soil Nutrient Tests	December 1 – December 15	One Application to all plants
	October 15 - October 31 & April 1 - April 15	Perform 5 Soil tests at 5 locations. Test and adjust to specified values. (see 3.02)
Pruning – Deciduous Trees	November 15 - March 1	Prune dead, weak, interfering, suckered, damaged or unsightly twigs/branches; remove street tree branches that penetrate the area 8 feet above finished grade of pedestrian surfaces; pruning shall not diminish the natural character of the tree. All pruning operations shall be supervised by the Contractor's ISA Certified Arborist (NY)
Pruning – Deciduous Shrubs	June 1 - August 1	Remove 1/3 of old wood; remove stems that overhang sidewalks and/or remove suckers. Prune forsythia immediately after flowering. Review pruning procedure with Engineer prior to pruning. The Contractor's ISA Certified Arborist (NY) shall supervise all pruning operations.

Function	Schedule	Description
Trimming – Herbaceous Species	Immediately after flowering End of growing season for each individual bulb and perennial's requirements.	Remove all dead flowers & flower stalks & seed heads. Remove all dead leaves and cut plant stock 6" from ground.
Mulching	January - December	Check once/month; maintain mulch layer as shown on the Contract Drawings.
Tree Staples	April 15th and October 15th	Inspect for frost heave or girdled roots and adjust or remover, as per recommendations of the Contractor's ISA Certified Arborist (NY)
	One year from time of installation	Remove completely.
ISA Certified Arborist's Walk Through Site Inspections	April – December	Twice per month.
	January – March	Once per month Licensed Tree Expert's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "D"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW YORK)

APPENDIX "E"

COMPOST – SOLUBLE SALTS LEVELS

Use the following table* to determine the maximum allowable ECe(dS/m of saturation extract) of compost at the desired application rate:

Desired Use Rate		Salinity (ECe) of On-Site Soil		
Cubic Yards Amendment per 1000 Sq. Ft. for incorporation to 6" depth	Volume Percentage of Amendment	3 dS/m	2 dS/m	1 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9. 5	14
4	22	3. 5	7	10. 5
5	27	3	5. 5	8. 5
6	32	2. 5	4. 5	7

Example: If Specification calls for 6 cubic yards compost per 1000/sq. ft. to be incorporated into the top 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding an ECe of 4 in the final blend, compost ECe should be less than 4.5 dS/m.

* This table is as per "Compost – A Guide for Evaluating and Using Compost Materials as Soil Amendments", by William Darlington, Soil & Plant Laboratory, Inc. as published by the University of California Extension Service, Orange County Office.

END OF APPENDIX "E"

DIVISION 2

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for maintenance of permanent planting and hardscape, prior to rendition of the Certificate of Final Completion.

B. Maintain plantings, hardscape and automatic irrigation system listed in Item A of Appendix "D" to this Section that are within the "Areas of Work" shown on the Contract Drawings.

C. Perform functions as scheduled and described in Item B of Appendix "D" to this Section.

D. "Maintenance of Permanent Planting", "Maintenance of Landscaping", or "Landscaping Maintenance", or words of similar import, shall mean all the functions specified in Appendix "D" to this Section.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Perform maintenance operations using materials and methods in accordance with this Specification and Contract Drawings.

B. For botanical names of trees, shrubs and ground cover, refer to the names listed in "Hortus III: A Concise Dictionary of Plants Cultivated in the United States and Canada" published by MacMillan Publishing Co., New York, NY 10022.

C. To determine caliper, size, height, width and root spread of plants, use the "American Standard for Nursery Stock" ANSI Z 60.1-2004, published by the American Association of Nurserymen, 1000 Vermont Ave., NW, Suite 300, Washington, D.C. 20005.

D. Pruning methods shall be in accordance with the 'Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance, - Standard Practices,' ANSI - A 300, as published by the Tree Care Industry Association, 136 Harvey Rd., Suite 101, Londonerry, NH 03053.

E. As a guide to determine local weather predictions use the National and Local Forecast Hurricane, Radar and Report website at http://www.weather.com as published by the Weather Channel.

F. Mulch shall conform to current standards established by Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 20111-4245.

G. Perform replacement of items listed in Item A of Appendix "D" to this Section only during the appropriate growth season of the particular item. Provide plants of quality, size, genus, species and variety to match original installation(s).

1. Replace trees, shrubs, ground covers, lawn areas and other plants that are defective due to death, defoliation, disfigurement, infestation and off-color foliage.

2. Repair or replace lawn or ground cover areas due to erosion, bare or sparse growth, or weed or pest infestation.

H. In the case of loss or damage due to unusual phenomena or incidents, commence clean up within 48 hours of such loss or damage or notification of such loss or damage, and complete such Work within the scheduled time(s) as approved and directed by the Engineer.

I. Replacement plants furnished by the Contractor shall be subject to warranty for the same time period as the original installations.

J. Pest control for plants shall be in accordance with the "2006 Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs" published by Cornell University, Ithaca, NY. This publication is available from The Resource Center, Cornell University, Ithaca, NY 14853. Telephone (607)-255-9946

K. Maintain the automatic irrigation system as per Appendix 'D' of this Section to deliver required amounts of water to plantings as per 3.03 B and 3.03 K., 4. of this Section.

L. All materials, activities and procedures shall be in accordance with the Federal Aviation Administration (FAA) – Advisory Circular No. 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports", August 28, 2007.

M. Soil Testing Procedures shall be as per "Recommended Soil Testing Procedures For The Northeastern United States, current edition, Northeastern Regional Publication No. 493" as provided by the Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform operations only during the following weather conditions:

1. There shall be no frost in the ground and the soil and backfill materials temperature at each planting area shall be above 32 degrees F.

2. Perform planting and soil related operations only when no form of precipitation is falling or forecasted to fall within the next 2 hours. Following a period of precipitation, resume operations only after the soil has drained.

B. Planting Calendar Limitations

Planting shall be performed only during the following periods:

1. Deciduous Plants March 1 - May 1 and October 15 - December 1

2. Evergreen Plants April 1 - May 15 and September 1 - October 15

3. Perennials and bulbs - as shown on the Contract Drawings.

4. Seeding – as per Section 02930 Appendix B.

C. Apply chemicals only when wind velocity does not exceed 5 mph, drift hazard is negligible, the air temperature is above 40 degrees Fahrenheit and below 70 degrees Fahrenheit, no precipitation has fallen within 2 hours prior to application, and no precipitation is forecasted for the 12 hour period after application.

1.04 QUALITY ASSURANCE

A. Contractor's Personnel Qualifications:

1. Verify that the entity performing the Work of this Section employs workers experienced in landscaping and landscape maintenance and has engaged in Work similar to the requirements of this Section for a period of at least 5 years.

2. Verify that the entity performing pesticide applications is licensed as a commercial applicator by the state in which the Work is being performed.

3. Verify that the entity performing pruning, planting and maintenance of this Section is a member of the International Society of Arboriculture and State Chapter where it is located.

4. Verify that the entity performing the Work of this Section shall have a New Jersey Licensed Tree Expert available within (24) twenty-four hours upon request.

   a. Verify that the entity performing the Work of this Contract has a New Jersey Licensed Tree Expert on staff qualified as follows:

      (1) Associates Degree in Horticulture from a recognized college.

      (2) A total of five (5) years of work experience.

      (3) A member of the International Society of Arboriculture and State Chapter where they are residing.

      (4) Qualified as a Licensed Tree Expert by the New Jersey Board of Tree Experts during the year(s) this individual is working on this Contract.

   b. Quality Assurance

      (1) Qualifications: Ensure that the entity performing the Work of this Contract utilizes the services of a New Jersey Licensed Tree Expert who shall act as superintendent for the installation and all maintenance of plantings for this Contract and who shall be on site at all times including but not limited to the following events and occasions: inspects replacement trees at the Nursery where they are grown, plant material (tree) deliveries, maintenance of plants at the site after delivery and prior to installation, verifying the root flare on all trees prior to planting, guying and staking of trees, mulching, pest management, transplanting of existing trees, application of bio-stimulants to all plant materials and notifying the Engineer of any discrepancies or non-compliance to the Contract Specifications and Drawings.

5. Verify that the laboratory performing the laboratory testing of this Section is a certified testing laboratory such as Rutgers Soil Testing Laboratory, Rutgers Cooperative Research & Extension, New Jersey Agricultural Experiment Station, Milltown, NJ 08850, or approved equal, in either the State of New Jersey or New York, and shall have experience in topsoil testing for soil

properties important for plant and turf management and shall perform all tests as specified in 2.01 A, 2.01 B and as outlined in Appendix B and Appendix C of this Section.

B. General Requirements for Operations and Products

1. Products listed in PART 2 - PRODUCTS shall be approved in writing by the Engineer prior to delivery to the construction site.

2. After delivery to the construction site, the Engineer, at his discretion, may take representative samples of any item listed in Part 2 – Products for analysis. Products which fail to comply with these Specifications shall be immediately removed from the construction site and replaced with products which comply. No Work will be permitted until the non-complying product is removed from the construction site and replaced with one which complies with these Specifications.

3. The Contractor shall obtain, retain, and make available for on-site inspection at all times, U.S. Department of Labor, Material Safety Data Sheets for all toxic substances and hazardous materials to be used in this Contract. One copy of said sheets shall be given to the Engineer for review and approval prior to introduction of material to the construction site.

4. All plant materials shall be grown in nurseries located within the following states: Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

5. All plant material shall be 'Nursery Grown.' Nursery Grown shall mean that the fields, where the plants are to be obtained, are from active and working nurseries where the following horticultural practices have been aggressively performed:

   a. IPM Program - Integrated Pest Management Program

   b. Cultivation - Including weed suppression

   c. Fertilization

   d. Pruning

   e. Irrigation

   Any plant material from a field where the above horticultural practices have not been consistently practiced in the last twelve (12) months shall be rejected.

6. Soil Nutrients

   a. Submit within the first three months of each year a minimum of five (5) soil samples taken six (6) inches below the soil surface from five (5) different locations within planted area(s) for analysis by a certified independent laboratory. Testing for each sample shall include NH4, NO3, P2O5, K2O, Fe, soluble salts, pH and organic matter.

   b. Submit test results to the Engineer.

   The Engineer may take soil and leaf samples for analysis. In the event that the test results indicate that the Contractor has failed to or improperly applied any nutrient control product, make all corrections including replacement of plantings in kind at no cost to the Authority, immediately upon notification by the Engineer.

7. Pesticide

a. Select to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.

b. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate products at the construction site only in a work area designated by the Engineer.

c. Keep all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within 5 days when so requested.

d. Not less than forty-eight hours prior to a proposed spray operation, submit to the Engineer for his approval, a tabulated list indicating the target to be treated, the chemical trade name and quantity of mix being prepared.

e. All pesticide/herbicide applications shall be subject to inspections by the Engineer. The Engineer may at any time, suspend and reschedule a pesticide/herbicide application when, in his determination, the weather conditions are unfavorable, facility operations would be hampered or the Contractor's methods or materials fail to comply with these Specifications.

8. Asian Longhorned Beetle

The Contractor shall be aware of the possibility of encountering the Asian longhorned beetle. If beetles are observed or suspected of being present, the Contractor shall immediately notify the Engineer and is requested to contact: New Jersey Department of Agriculture, Division of Plant Industry, P.O. Box 330, Room 303, Trenton, NJ, 08625-0330, Telephone: (609)-292-5441.

C. Specific Requirements for Operations and Products

1. Plants

a. Coordinate all arrangements and accompany the Engineer on all inspections of plants at the nursery. Provide a minimum of 48 hours prior notice to the Engineer. Do not dig or remove any plant prior to inspection by the Engineer.

b. All plants inspected by the Engineer at the nursery will be sealed with Authority seals, or at the discretion of the Engineer, typical representative numbers of such plants may be sealed.

c. Deliver to the construction site plants which were sealed and whose seal numbers conform to the Engineer 's nursery inspection records.

d. Unsealed plants that, in the sole opinion of the Engineer, are not equal in quality to the sealed samples will be rejected.

e. Each shipment shall be certified by Federal and State authorities to be free of insects and diseases. Inspection certificates to this effect that would be required by law, if the Authority were a private corporation, shall accompany each shipment invoice and shall be delivered to the Engineer.

f. All plants, sealed or unsealed, shall be subject to tailgate inspection upon arrival at the construction site. All plants failing to meet the requirements of this Section will be rejected by the Engineer. Such rejected plants shall be removed from Authority property and replaced at no additional cost to the Authority.

g. At the discretion of the Engineer, typical representative numbers of plants may be removed from their growing containers for inspection.

2. Drive/Walk Through Site Inspections

a. During the maintenance period, the Contractor's Licensed Tree Expert (NJ) and the Contractor shall perform bi-weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer, to address the following:

(1) Identifying the status of the Work.

(2) Issues or problems requiring immediate action by the Contractor.

(3) Items affecting the Contractor's work.

b. Within 48 hours of each site inspection, the Contractor's Licensed Tree Expert (NJ) shall submit a report stating the following:

(1) List site inspection attendees.

(2) Agenda and item(s) discussed.

(3) Description of the issues or problems.

(4) Solutions to be implemented by the Contractor with a schedule designating dates when the Contractor will implement said Work.

3. Screened Loam Soil

a. Prior to delivery to the construction site, submit a representative sample of screened Loam Soil for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01 A. No substitution for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 A and Appendix B of this Section.

b. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

c. Prior to delivery to the construction site, the Contractor shall submit to the Chief of Materials Engineering the following:

1.) The location of the source of the screened loam soil.

2.) A certified analysis of the loam soil that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation".

4.) A two pound sample for each 100 CY of screened loam soil delivered to the construction site.

5.) In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to this specification, all at no cost to the Authority.

d. Do not deliver screened Loam Soil to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

e. After delivery of screened loam soil to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 A. Submit test results to the Chief of Materials Engineering for approval for upto each 100 CY of screened loam soil delivered to the construction site. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened Loam Soil from the construction site and replace it with material that does conform, at no cost to the Authority

4. Planting Mix

a. Do not combine planting mix components until components have been approved in writing by the Chief of Materials Engineering.

b. After mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the planting mix to a certified independent laboratory to ensure conformance to requirements specified in 2.01 B. No substitutions for testing parameters shall be permitted. Submit test results to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 2.01 B and Appendix C of this Section.

c. Any analysis, where by the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site shall not be accepted.

d. Prior to delivery to the construction site, submit to the Chief of Materials Engneering the following:

1.) The location of the source of the planting mix and the name and address of the supplier.

2.) A certified analysis of the planting mix that meets this specification.

3.) A "Landscape Level 3 Topsoil Evaluation" for the crop identified as ornamental plants.

4.) A two pound sample.

5.) In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

6.) A letter certifying that the source components and the suppliers of the planting mix are all as approved by the Chief of Materials Engineering and that no substitutions have been made regarding the source components and the suppliers without prior approval by the Engineer.

e. Do not deliver planting mix to the construction site until the Chief of Materials Engineering has approved the submittal in writing.

f. After delivery of planting mix to the construction site, submit a representative sample for analysis to a certified, independent laboratory to ensure conformance to requirements specified in 2.01 B. Submit test results to the Chief of Materials Engineering for approval. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered Planting mix from the construction site and replace it with material that does conform,all at no cost to the Authority.

5. Compost

a. Prior to delivery of compost to the construction site, submit to the Chief of Materials Engineering the following:

1). The location of the source of compost and the name and address of the supplier.

2). A certified analysis of the compost that it meets the specifications herein. Any analysis of which the date of testing by the certified independent laboratory is in excess of one month prior to the actual date of delivery to the construction site will not be accepted.

3). A ¼ pound sample.

4). In the event that the sample/analysis does not conform to the specified requirements, submit additional samples/analyses until the results do conform to the specifications, all at no cost to the Authority.

6. Lawn Mower Equipment

a. Verify that the entity performing lawn mowing utilizes a Mulching Mower, capable of producing a fine mulch and produce no windrows. Provide a list of lawn mowers to be used as well as the manufacturer catalog cuts describing how the mulching mower operates to produce a fine mulch and no windrows.

D. Certification

1. Verify that the concentration of environmental parameters in all soil mixes shall not exceed the NJDEP's Residential Direct Contact Soil Cleanup Criteria as stated in N.J.A.C. 7:26D.

2. A letter certifying that the source components and the suppliers for soil mixes are all approved by the Chief of Materials Engineering and that no substitutions have been made to the source components and the suppliers without the approval of the Engineer.

E. Replacement

1. Replace unsatisfactory furnished and installed trees, shrubs, ground cover and perennials which, in the sole opinion of the Engineer, die or otherwise become unsatisfactory according with all requirements of the Contract Drawings.

2. Replace unsatisfactory plants with products and by operations that comply with all requirements of the Contract Drawings, and on such date(s) as ordered by the Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.

B. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

C. Formulation, Application and Equipment

1. Use the manufacturer's recommended formula, application rate and safety instructions at all times.

2. Mix and agitate products and use equipment according to the manufacturer's directions. Mix and agitate only in an area designated by the Engineer.

3. Dispose of spilled materials and surplus products away from Authority property.

D. Specific Requirements

1. Screened Loam Soil,Planting Mix and Compost:

Conform to requirements of 1.04 C.3,1.04 C.4 and 1.04 C. 5.

2. Plants

Conform to requirements of 1.04 C.1 and as follows:

a. Transport plants in covered trucks only. Plants transported on open trucks from the nursery will be rejected by the Engineer.

b. Handle balled and burlapped trees on the ground using the method shown on the Contract Drawings.

c. Carry plants by the ball or container and not by stems.

d. Do not drop plants.

e. Protect all delivered plants from drying out by providing shade and water. Do not allow plants to become dry or wilted.

f. After plants have been set on the ground, apply water as needed, and cover balls with plastic sheeting.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Screened Loam Soil

Fertile, friable, natural loam, free of subsoil, taken from a depth of no more than 1 foot, or less if subsoil is encountered, supplier-certified as having been obtained from an area which has never been treated with herbicide and conforming to the following:

1. Screened Loam Soil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, lime, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, sticks, glass or any other undesirable material.

2. Screened Loam Soil shall contain a minimum of 5 percent organic matter and maximum of 7 percent organic matter as determined by loss of ignition of moisture-free samples.

3. pH range shall be 5.0 to 7.0, inclusive.

4. The range of soluble salts shall be equal to or less than 500 micromhos per centimeter.

5. Screened Loam Soil shall be graded as follows:

Passing	Retained On	Percentage
1" screen		100%
1" screen	2mm (No.10) Sieve	Not more than 40%*

*The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.

6. The portion of screened Loam Soil passing the 2mm sieve, based on the mechanical analysis of the soil as determined by the Buoyoucous Hydrometer method, shall consist of the following based on dry weight of sample:

   a. Sand 40%-60%, inclusive
   b. Silt 30%-40%, inclusive
   c. Clay 10%-20%, inclusive

B. Planting Mixes

Composed of screened loam soil, various soil amendments and nutrient control materials conforming to the following:

1. Planting mix shall contain a minimum of 7% and a maximum of 15% organic matter as determined by loss on ignition of moisture free samples, and the pH range of 5.0 to 7.0, inclusive, with 60% passing a 1" screen.

2. The range of soluble salts shall be equal to or less than 1250 micromhos per centimeter.

3. Each 5 cubic yards of planting mix shall contain:
   a. 3 3/4 cubic yards of screened loam soil;
   b. 1 1/4 cubic yards of compost
   c. 17 lbs. of Hydrogel

4. Planting mix shall be loose, friable and not frozen or saturated at the time of mixing.

C. Compost

1. Compost shall be free of viable weed seeds and contain materials of a generally humus nature. The product shall not contain any materials toxic to plant growth or produce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. Variations in the following specified physical properties are not acceptable. Compost shall conform to the following:

Parameters	Range
pH	5.7 – 7.7
Moisture Content	35% - 55%
C:N Ratio	15 – 30:1
Organic Matter	>50%
Soluble Salts	<5.0 mmhos/cm (ds/m)
Saturated Paste Method	
Nitrogen	>1.5%
Phosphorus	>0.5%
Potassium	>0.1%

*See Appendix "E" for allowable compost application rates based upon soluble salts levels.

D. Weed Control

1. Pre-emergent Herbicide

"Treflan 5G" as manufactured by Elanco Products Co., Indianapolis, IN 46285 or approved equal.

2. Post-emergent Herbicide/Glyphosate.

a. "Round-up Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

41% - Glyphosate N - (phosphonomethyl) glycine

59% - Inert Ingredients

b. "Rodeo" as manufactured by Dow AgroSciences, Indianapolis, IN 46268 or approved equal conforming to the following:

53.8% - Glyphosate N – (phosphonomethyl) glycine

E. 46.2% - Inert IngredientsHydrogel

1. "Viterra Gelscape" as manufactured by Amereq, Inc., New City, NY 10956.
2. "Super Sorb" as manufactured by Aquatrols Corps of America, Inc., Cherry Hill, NJ 08003.
3. "Soil Moist" as manufactured by JRM Chemical Inc., Cleveland OH 44125
4. "AquaGel A, B, C, D" as manufactured by Profile Products, Buffalo Grove, IL 60089
5. Or approved equal.

F. Nursery Stock

1. Furnish plants in the quantity, species, and meeting the size, height and width requirements as shown on the Contract Drawings.
2. Furnished plants shall conform to the following:
   a. Measure plant size as it stands in its natural position.
   b. Conform to tree caliper, plant sizes, heights and widths as shown on Contract Drawings.
   c. For container grown plants, if used, conform to the dimensions for height, width, number of canes and container size as shown on the Contract Drawings.
   d. Plants furnished shall be an average of the minimum and maximum sizes shown on the Contract Drawings.
   e. Do not use large plants cut back to sizes specified.
   f. Plants shall be sound, healthy, vigorous growing specimens.
   g. Plants shall exhibit uniform growth and a form characteristic of their species.
   h. With respect to their canes, trunks, stems, and branches, shrubs shall:
      (1) Have normal, well-developed canes and branches.
      (2) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sunscald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, damage due to machinery operation, improper pruning and blasted buds.
   i. Plants' foliage shall be free from chlorosis, yellowing, blemishes or damaged parts.
   j. Plants shall have vigorous, fibrous root systems.
   k. Container grown plants, if used, shall have been grown in the container long enough to develop new fibrous roots so that the root mass will retain its shape and hold together when removed from the container. Recently potted or root-bound plants will not be accepted by the Engineer. Container-grown plants shallbe free from girdling roots.

l. With respect to their trunks and branches, trees shall:

(a.) Have normal, well-developed branches.

(b.) Be free from any infestations or defects, including but not limited to decay, disfiguring, knots, frost and sunscald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, damage due to machinery operation, improper pruning and blasted buds.

(c.) Have straight trunks with a sturdy central leader. Clump forms may have more than one straight leader. Lateral branches shall arise near right angles forming a U-shaped crotch. Trees with V-shaped crotches will be rejected by the Engineer.

(d.) Have been properly pruned to ensure a strong, sturdy, symmetrically shapedcanopy.

(e) Root flare exposed and no more than two inches of native soil or container soil found to be above the tree or shrubs natural root flare at the trunk.

(f) Whenever, the root flare is not exposed, an airspade shall be employed to expose the natural root flare. The cost of airspading or other methods to remove soil found above the natural root flare shall be at not additional cost to the Authority. Airspading or other methods employed to remove soil from above the natural root flare shall be performed in the presence of the Contractor's Licensed Tree Expert (NJ).

m. With respect to their roots, trees shall:

(1) Be free from girdling roots.

(2) If girdling roots are present, then the Contractor's Licensed Tree Expert (NJ)shall remove them at no cost to the Authority.

(3) If it is determined that the girdling root cannot be satisfactorily removed by the Contractor's Licensed Tree Expert (NJ), then remove the affected tree immediately and replace it with a tree that meets this specification, at no additional cost to the Authority.

(4) Bareroot plants shall be prohibited.

3. Instructions for digging and balling plants are as follows:

a. Dig immediately before moving.

b. Dig to retain as many fibrous roots as possible.

c. Do not use loose, broken or manufactured balls.

d. Wrap and tie balled and burlapped plants with untreated burlap and sisal or jute twine. Do not ball and tie with treated (or "no rot") material.

e. Trees – Trunk Flare

(1) Trees shall have all excess soil removed from the top of the true root ball and full exposure of the trunk flare, prior to ball and burlap operations at the Nursery.

(2) The cost of airspading or other methods to remove soil found above the natural root flare shall be at no additional cost to the Authority.

(3) Trees delivered to the construction site with 2" depth (or greater) of excess soil on top of the true root ball and unexposed trunk flare will be rejected by the Engineer.

G. Bulb-Tone

Pure, sterilized, non-burning source of nitrogen, phosphorus, potash, calcium and trace elements. Bulb-Tone shall be dustless, greaseless, odorless, and natural organic. Bulb-Tone shall be as manufactured by Espoma Products, Millville, NJ 08332 or an approved equal.

The statement of Guaranteed Analysis shall be as follows:

Total Nitrogen (N)	4.0%	Boron (B)	0.02%
2.4%.....Water Soluble Nitrogen		Chlorine (Cl)	0.1%
1.6%...Water Insoluble Nitrogen		Cobalt (Co)	0.0005%
Available Phosphate (P2O5)	10.0%	Copper (Cu)	0.05%
Soluble Potash (K2O)	6.0%	Iron (Fe)	1.0%
Calcium (Ca)	3.0%	Total Manganese (Mn)	0.05%
Total Magnesium (Mg)	0.5%	Molybdenum (Mo)	0.0005%
0.3%...Water Soluble Magnesium		Sodium (Na)	0.1%
Sulfur (S)	5.0%	Zinc (Zn)	0.05%

H. Soil pH Adjustment

1. Elemental Sulfur

Guaranteed analysis shall be:

0% Nitrogen

0% Phosphorus

0% Potassium

90% Sulfur

2. Granulated Dolomotic Limestone

As manufactured by Limecrest, Sparta, NJ 07871, or approved equal conforming to the following:

a. Total carbonates not less than 86% of 48.2% calcium oxide equivalent. For purposes of calculation, total carbonates shall be considered as calcium oxide. Magnesium oxide content shall be between 15-22%.

b. A dust-free, homogenous, granular material.

I. Bio-Stimulants

1. Bio-Stimulant shall be a dry, water soluble root growth stimulant with nitrogen-fixing, phosphorus solubilizing and growth promoting bacteria packaged in ¼ pound (114 grams), pre-measured packs conforming to the following:

Ingredients:	% by Weight
Humates and Humic Acid	40%
Cold Water Sea Kelp Extract	35%
Essential Amino Acids (18)	7%
Sucrose and other Natural Sugars	6%
Citric Acid	5%
Vitamins and Growth Factors	2% (including B1, B2, B6, B12, Biotin, Folic Acid, Niacin and Vitamin K)
Nitrogen Fixing Bacteria	Approx. 60 Billion per Pound
Phosphorus Solubilizing Bacteria	Approx. 60 Billion per Pound
Growth Promoting Bacteria	Approx. 60 Billion per Pound
12% Potassium (K2O) derived from Humate and Kelp Extracts	

2. Bio-Stimulant shall bw "PHC BioPak Water Soluble Powder" as manufactured by Plant Health Care, Inc., Pittsburgh, PA 15238, or an approved equal.

J. Rodent Control

1. Rodent Control shall be a water soluble, non-toxic, colorless solution with the following active ingredients:

Ingredient:	Percentage:
Benzyldiethyl (2.6 xylycarbamoyl) Methyl, Ammonium Saccharide	0.065%
Thymol	0.035%
Inert Ingredients	99.9%

2. Rodent Control shall be "RO-PEL" as manufactured by Burlington Bio-Medical & Scientific Corp., Farmingdale, NY 11735-1527 or an approved equal.

K. Pruning Alcohol

A commercial ethylalcohol or "Ethanol" 70-95%.

L. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend.

M. Tree Staples

1. Tree Staples shall be uncoated, cold-rolled, plain carbon steel 'Tree Staples' as manufactured by Tree Staple Inc., New Providence, New Jersey, 07974. Tree Staples are protected under U.S. Patent No's. 6, 141, 903, & 6,065,243.
2. Tree Staple sizes as shown on the Contract Drawings.
3. Tree Staples are available from the following suppliers:
   a.) NYP Corp., 805 East Grand Street, Elizabeth, New Jersey, 07201.
   b.) Northern Nurseries, 487 Elizabeth Avenue, Somerset, New Jersey, 08873.
   c.) Northeastern Supply, 50 Notch Road, West Paterson, New Jersey, 07836.
   d.) Or approved equal.

N. TreeGator

1. TreeGator portable drip irrigation system shall conform to the following:
   a. Constructed of ultra-violet light stabilized, reinforced, rip-stop polyethylene with reinforced nylon zippers.
   b. Each TreeGator bag to have a 20 gallon water capacity and weigh 1 ½ pounds empty.
2. TreeGator Junior portable drip irrigation system shall conform to the following:
   a. Constructed of PVC with reinforced heat-sealed seams and removable vinyl emitter-system, which consists of a PVC-L Valve and a PVC Emitter Insert.
   b. Each TreeGator Junior to have a 14 gallon water capacity.
3. TreeGator and TreeGator Junior portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC, 27619-8187.

PART 3. EXECUTION

3.01 PREPARATION

A. Maintenance of Traffic and Work Area Protection

1. No heavy equipment, including trucks, may be used on paved pedestrian or sidewalk areas during maintenance operations unless approved by the Engineer.
2. Demarcate Work area(s) with roping and traffic cones. Cones shall be reflectorized orange rubber with approximate height, width and wall thickness respectively of 28 inches, 15 inches, 1/8 inch, as manufactured by Western Marketing Service, Union City, NJ, or approved equal. Cones shall bear the Contractor's identification, burned or painted on.

B. For pesticide preparation, conform to 1.04 B.7 and 3.03 E of this Section.

C. For pruning, conform to 3.03 F of this Section.

D. For tree removal, conform to 3.03 H of this Section.

3.02 FIELD TESTS

A. Nutrient Control

Identify nutrient, soluble salt and pH levels in accordance with 1.04 B. 6. of this Section, and perform practices in accordance with Appendix "D" and as follows:

1. Perform nutrient applications 48 hours after irrigation to ensure proper soil moisture levels.

2. In the event that the accumulation of soluble salts is above 500 microhmos per centimeter, leach affected planter twice by applying 1 gallon of water per square foot of planter area, wait 1 hour before repeating procedure. Continue procedure until affected planter reaches an acceptable level of soluble salts.

3. In the event that the soil pH is below 5.5 for non-ericaceous plants and 4.5 for ericaceous plants, broadcast granulated dolomitic limestone at the rate recommended by the manufacturer. Repeat application as required.

4. In the event that the pH is above 8.0 for non-ericaceous plants and 6.5 for ericaceous plants, broadcast elemental sulfurat the rate recommended by the manufacturer.

5. In the event that the soil test results indicate a deficiency of iron, broadcast Chelated Iron at the rate recommended by the manufacturer. Repeat applications as required.

6. In the event that soil test results indicate a deficiency of nutrients, nitrogen, potassium and phosphorous, apply nutrients at the rate recommended by the manufacturer. Repeat applications as required.

7. Bio-Stimulant Applications

   a. Perform two (2) applications of Bio-Stimulants annually to all trees, shrubs, ground cover and seasonal display (perennials) plantings to be maintained under this Contract in accordance with Appendix 'D'.

   b. Arrange for Bio-Stimulants to be applied under the supervision of the Contractor's LicensedTree Expert (NJ) and the Engineer.

   c. Apply Bio-Stimulant as per the manufacturer's directions and as follows:

      One (1) pound of Bio-Stimulant powder per 100 gallons water.

3.03 ADJUSTMENTS

A. Perform maintenance operations in accordance with Item B of Appendix "D" to this Section.

B. Irrigation

1. Trees and Shrubs

Frequency will vary depending on environmental factors. The total amount of water, from natural or applied irrigation shall be not less than one inch per week.

2. Herbaceous Species

C. During periods of irrigation, add a minimum of ½ of an inch of water during any oneirrigation period and up to three (3) inches per week.Mowing of Lawn Areas

1. Maintain a maximum height of 2 1/2 inches.
2. Trim edges.
3. Remove clippings after mowing and trimming.
4. Broom clean clippings from adjacent paved areas.

D. Sanitation

1. Weeding
   a. Manually remove weeds before growth and maintain all permanent planting areas and hardscape areas "weed-free" at all times.
   b. Identify weeds and apply selective pre-emergent and post-emergent herbicides according to Part 3.03 E of this Section.
   c. Remove spent flower heads on flowering shrubs and perennials as shown in Appendix "D".
2. Litter Removal

   Maintain planting and paved areas located within the "area of work" shown on the Contract Drawings free of litter or debris of any type.

E. Pest Control

Shall include but not be limited to managing insect, weeds and disease pests using the Integrated Pest Management (IPM) concept, the identification of pests, monitoring pest activity and population, the submittal of a pest control program and the proper application of pesticides, avoiding injury to non-target organisms and the environment, and as follows:

1. Notify the Engineer of infested plants.
2. Apply specific pesticides in accordance with Appendix "D".
3. Identify plant pests in their early stage of development and within 48 hours of identifying a pest on any plant, proceed as follows:
   a. Specify the number of plants or planted areas requiring treatment, and their locations.
   b. Submit written pesticide program in accordance with 1.04 B.7 of this Section.
   c. Failure to notify the Engineer prior to severe infestation shall mean the Contractor accepts full responsibility for the health of permanent planting including replacement In-Kind with a pest-free and disease-free plant.
4. During Pesticide Application Operations the following shall apply:

a. Applicators shall be properly licensed in accordance with 1.04 A.2 of this Section and attired with protective clothing, gloves and other required equipment.

b. Equipment shall be clean, safe, leak-free and in good working order. Remove malfunctioning equipment from the work site.

c. Secure the area from pedestrian traffic by roping off the area and place signs as directed by the Engineer.

d. Provide workers to supervise the operation and to keep pedestrians from approaching within 50 feet of area.

e. Protect all areas from spills and immediately report spills to the Engineer.

F. Pruning

1. Prune all plants in order to maintain healthy compact growth.

2. Prune in accordance with the National Arborist Association's ANSI A300 "Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices" and in accordance with Appendix "D" and as follows:

a. Provide and maintain a traffic cone and rope barricade around all work areas during pruning operations.

b. Provide a worker on the ground to redirect pedestrian traffic during tree pruning operations.

c. Perform pruning with sharp tools. Disinfect tools by dipping in alcohol at the commencement of the day's operation and again after finishing each plant known to be diseased. Use fresh alcohol each day for this operation.

d. Prune to remove dead, weak, interfering, suckered, damaged or unsightly twigs or branches.

3. Prune to maintain the species' characteristic shape.

4. In addition, prune shrubs, perennials, and ground covers and deadhead flowers to control and renew growth and prolong flowereing in accordance with Appendix "D".

5. No tree climbing permitted. For trees less than 15 feet in height, use free standing ladders and do not touch the tree trunk.

6. Do not disturb utility lines during pruning operations.

7. Do not use anvil-type, pruning tools.

8. Make pruning cuts at the branch collar. Crushed, jagged cuts or cuts leaving too much stub and existing improper cuts are to be properly re-cut.

9. Carefully clean and shape large wounds.

G. Winter Protection

Protect plantings in accordance with Appendix "D" and as follows:

1. Apply anti-desiccant with a power sprayer to provide adequate protective film over trunks, branches, twigs and/or foliage.

H. Tree, Shrub and Ground Cover Removals

1. Within 24 hours of notification by the Engineer, remove, at the Contractor's expense, all plants that are dead or otherwise become unsatisfactory as directed by the Engineer. However, if it can be proven to the Engineer, that the plant's death was not due to neglect or abuse caused by the Contractor, the Contractor will not be responsible for cost of such replacement.

2. Prior to commencing removal operation, obtain the Engineer's approval of proposed removal methods and equipment.

   a. Rope all areas surrounding the trees being worked on and provide a ground person to direct pedestrian traffic.

   b. Remove the tree stump and root ball completely.

   c. Manually remove all shrubs, perennials and ground cover.

   d. Remove and dispose of all debris away from Authority property.

I. Tree Staple Maintenance

1. In accordance with Appendix 'D' or as directed by the Engineer, monitor the integrity of all tree staples installed under this Contract. Re-spike and adjust tree staples that have been heaved by frost and verify the structural condition of all tree staples installed under this Contract.

2. In instances where the tree roots may be girdled by tree staples, verify these conditions in the presence of the Contractor's and Authority's New Jersey Tree Expert and if required, remove tree staples as directed by the Contractor's New Jersey Tree Expert and the Engineer.

3. In accordance with Appendix "D" or as directed by the Engineer, remove and dispose of tree staples away from Authority property.

J. Mulching

1. Maintain shredded hardwood bark mulch to a maximum depth of two (2) inches at all times. Adjust mulch layer in accordance with Appendix "D", the Contract Drawings, and as directed by the Engineer.

2. Maintain a minimum radius of 4 inches between the tree or shrub trunk flare and the start of the mulch.

3. Mulch Volcanoes shall be prohibited. Wherever mulch is inappropriately applied, the Contractor shall remove the inappropriately installed mulch from the construction site and replace it in conformance with the Contract Drawings. All at the expense of the Contractor.

K. Perennials and Bulbs

1. Maintain perennials and bulbs in accordance with Appendix "D"..

2. Conduct operations in a neat and orderly manner.

3. Planting Operation

   a. Excavation of Plant Holes

      (1) Hand trowel plant hole excavations.

(2) Plant each plant in individual holes.

(3) Dig plant holes two inches wider than the container in which the plant was delivered.

b. Planting

(1) Perform planting only if approved by the Engineer, and in the presence of the Engineer.

(2) Remove only those plants from storage that are to be immediately installed. Do not leave any unplanted plants unattended at the construction site.

(3) Perform planting only during periods of dry weather and when the ambient soil temperature at six-inch depth is above 0 degrees C (32 degrees F).

(4) Remove plants from pots, butterfly roots, and place in holes. Remove and dispose of all pots away from Authority property.

(5) In general, plants shall stand, after settlement, at the same level in relation to the finished grade as the level at which they have grown.

(6) Set plants plumb.

(7) Take care to avoid bruising or breaking the roots or tops of plants. Plants damaged during the planting operation will be rejected by the Engineer.

(8) At the time of planting, thoroughly saturate the topsoil mix around each plant with water.

(9) After installation is completed, remaining plants will become the responsibility of the Contractor to maintain for use as replacements, as directed by the Engineer.

(10) Bulb Planting

(a.) Spade and loosen soil to depth of 10 inches throughout entire area to receive bulbs. Spread and mix five (5) pounds of Bulb-Tone thoroughly into each 100 square feet of planting bed.

(b.) Dig bulb holes twice the diameter of the bulb. Set daffodil bulbs three times as deep as their diameter, measuring not to the tip of the bulb, but where the tip swells to form a shoulder. Set tulip bulbs so they are covered with six inches of soil. Bulbs to be planted in masses shall have the complete area excavated to the specified depth.

4. Irrigation

a. During periods of irrigation, add a minimum of 1/2 of an inch of water during any one irrigation period and up to three inches per week.

b. In the event, that the Engineer, in his sole opinion determines that the Contractor has failed to water the plantings according to these Specifications, he will notify the Contractor who, at his own expense, shall immediately make corrections as directed. Upon the second of such notifications, the Engineer shall withhold a portion of the Contractor's monthly payment as he deems necessary to cover the cost of replacement plants in the event that the plants die due to lack of water.

5. Maintenance of Plants

a. Within 24 hours of notification by the Engineer, replace, at the Contractor's expense, all plants that stop flowering or fail to flower, as determined by the Engineer. However, if it can be proven to the Engineer, that the lack of flowers was not due to neglect or abuse caused by the Contractor, the Contractor will not be responsible for cost of such replacements.

b. Pinch, shape and remove vegetative buds as necessary to maintain a compact, vigorous plant and encourage flower bud production on flowering varieties.

c. Remove all dead flowers and flower stalks immediately after flowering to encourage flower bud production on flowering varieties.

d. Provide approved plant support stakes and tying material to provide structural support whenever plant varieties require this form of maintenance. Adjust stakes to provide straight and secure plants.

L. Arborist's Site Inspections/Reports

1.) During the installation and maintenance period arrange for the Contractor's Licensed Tree Expert (NJ) along with the Contractor to be available to perform bi-weekly drive and walk-through site inspections of the Area of Work, accompanied by the Engineer, identifying the status of the work, issues or problems requiring immediate action by the Contractor or items affecting the Contractor's work.

2.) Within 48 hours of each site inspection, the Contractor's Licensed Tree Expert (NJ) shall tansmit to the Engineer a Maintenance Inspection Report, to inclcude but not be limited to: list of inspection attendees, item(s) discussed, brief discription of the issues or problems found, recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

M. Rodent Control Applications

1. Apply a minimum of two (2) rodent control applications per year, between November 1st and December 15th, as per the manufacturer's directions and in accordance with Appendix 'D'.

2. Rodent control shall be applied in the presence of the Engineer.

N. Precast Concrete Block Pavement

Maintain the Precast Concrete Block Pavement shown on the Contract Drawings free of weeds, litter, debris and any other deleterious materials and in accordance with Appendix 'D'.

END OF SECTION

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 - General Provisions:

A. Qualifications

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the entity performing the laboratory testing of this Section to the Engineer in accordance with 1.04 A. Include the name, address and telephone number of the Testing laboratory performing the work of this Section.

2. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit evidence of the entity's membership in the International Society of Arboriculture and State Chapter where they are residing.

3. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications in writing for approval by the Engineer of the New Jersey Certified Tree Expert performing the Work in accordance with 1.04 A.4. Include the name of the arborist, resume, and a description and contract amounts for work performed in the last two years.

4. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit qualifications of the entity and its workers performing the Work of this Section to the Engineer in accordance with 1.04 A. Include names of clients, telephone numbers, and contract amounts for work performed in the last three years and experience records of workers performing the Work of this Section, and evidence of license of pesticide applicator.

B. Products

1. Within fifteen (15) days of receipt by the Contractor of the acceptance of his Proposal, submit the following:

   a. A complete "Product List", listing all products to be used under this Section;

   b. A complete "Plant List", listing all greenhouse and nursery sources for the trees, shrubs and ground cover.

2. Submit the location of the source of the screened topsoil, topsoil mix and a two-pound representative sample of screened topsoil and topsoil mix (as many as required) to the Engineer of Materials in accordance with 1.04 C.3. and 1.04 C.4.

3. Submit a minimum of five (5) soil analyses within the first three months of each year of maintenance in accordance with 1.04 B.6.a.

4. Submit the quantity of Automatic Irrigation System Spare Parts within the first 30 days of each year of maintenance in accordance with 1.06 of this Section.

C. Test Reports

Submit laboratory analyses of screened topsoil and topsoil mix to the Engineer of Materials, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, in accordance to 1.04 C.3, 1.04 C.4, Appendix B and Appendix C.

D. Maintenance Reports

1. Once a month, submit to the Engineer an inventory of dead plants to be replaced. Replacement of planting shall follow the same procedures set forth in the Specification Sections 02954, 02971 (herein) and the Contract Drawings.
2. Prior to completion of all work, submit to the Engineer an inventory of pesticides used and pests identified in all the Areas of Work.

E. Certified Tree Expert's Inspection Reports

1. Within 48 hours of each site inspection, the Contractor's New Jersey Certified Tree Expert shall submit to the Engineer an inspection report, to include but not be limited to the following: List of inspection attendees, the item(s) discussed, a brief description of maintenance issues or problems found and recommendations for solutions to be implemented by the Contractor and a schedule designating dates when the Contractor will implement said work.

F. Certifications

1. Submit plant inspection certificates, in accordance with requirements of 1.04 C.1.e.
2. Submit to the Engineer of Materials, certification required by 1.04 D.

G. Notification

1. Pesticide application information, in accordance with 3.03 E of this Section.

END OF APPENDIX "A"

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "B"

Material: Screened Loam Soil

Specification: Section 02921 – Screened Loam Soil

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 5% Max. 7%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 500 Max. 300		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 20%		

END OF APPENDIX "B"

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "C"

Material: Planting Mix

Specification: Section 02954 – Trees, Shrubs and Ground Cover (New Jersey)

Source of Sample:

Contract or P.O. No.:

Quality Characteristics:	Spec.		
Visual Examination:	No hard clods, etc.		
Organic Matter: **(Loss on Ignition)**	Min. 7% Max. 15%		
Soluble Salts: **Micromhos/Cm** **PPM**	 Max. 1250 Max. 750		
pH:	5.0 - 7.0		
Mechanical Analysis:			
Passing - 1"	100%		
Passing - 1" **Retain 2mm (#10)**	Max. 40.0% The portion retained shall be no larger than 3/8" in size and composed of homogeneous clods and/or stones.		
Passing 2mm (#10) **Retain Pan**	Min. 60.0%		
Buoyoucous Hydrometer Test of Material:			
Passing 2mm (#10) **Percent – Sand**	 40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 20%		

END OF APPENDIX "C"

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "D"

A. Planting To Be Maintained

Trees
Shrubs
Ground Cover
Grass Lawn
Perennials
Precast Concrete Block Paver, Asphalt Blopck Pavement & Screenings

B. Maintenance To Be Performed

Function	Schedule	Description
Irrigation-(Manual & Tree Gator Bags)	April, May, Oct. & Nov. June, July, Aug. & Sept.	Water once per week. Water twice per week.
Automatic Irrigation System	April 19	Start-up system, Inspect all sprinkler heads and controllers, repair and replace as required. Check/adjust each zone timer (if required) to supply appropriate amounts of water to plantings and submit irrigation schedule to Engineer.
	April - November	Check System once per week and repair/adjust as required. Perform routine maintenance of system.
	November 15	Turn-off system, Blow-out water lines, Winterize entire system prior to freezing temperatures and as per the manufacturer's instructions. Submit an inventory of parts required for following year based upon the current season's demand
Mowing	May, June, July, Aug. & Sept.	Once a week
	Apr., Oct. & Nov.	Once every 2 weeks
Weed Removal	April – November	Identify/remove once/week

Function	Schedule	Description
Litter Removal	January - December	Once a week
Fallen Leaf Removal	October - December	Once a week until trees are defoliated. Rake/remove from work site.
Dead Plants/Parts Removal	May - November	Once/week; remove dead plants/branches/flowers, and seed heads
	June 15 – November 15	Submit an inventory of plants to be replaced during the next planting season.
Pesticides – Lawns	April - September	Check once/month; if infested, identify pest(s) and treat
Pre-Emergent Herbicide – Lawns	April 1 - April 30	One application
Post-Emergent Herbicide – Lawns	May 1 - May 30	One application
Pre-Emergent Herbicide – Shrubs, Groundcover and Perennials	April 1 - April 30	One application (Treflan 5G)
Pre-Emergent Herbicide –Precast Concrete Block Pavers Non-Landscaped Areas	April 1 - April 30	One application (Treflan)
Post-Emergent Herbicide –Precast Concrete Block Pavers Non-Landscaped Areas	June - September	As needed (Glyphosate)
Pesticides – Trees	Immediately prior to budbreak	One application of dormant oil
Pesticides – Trees, Shrubs & Ground Cover	April - September	Check once/month; if infested, identify pest(s) and treat.
	November 15	Submit an inventory of pesticides used and pests identified based upon the current season's findings.
Nutrient Control – Lawns	April 15 - May 15 & September 15 - October 15	One application granular 10-6-4

Function	Schedule	Description
Nutrient Control – Trees, Shrubs, Groundcover and Perennials		
Bio-Stimulant Applications:		Two Applications per Year as follows:
For Fall Planting Completion Date:	April 1 – April 15	One Application
	September 1 – September 15	One Application
For Spring Planting Completion Date:	September 1 – September 15	One Application
	April 1 – April 15	One Application
Rodent Control – All Plantings	November 1 – November 15	One Application to all plants
	December 1 – December 15	One Application to all plants
Soil Nutrient Tests	October 15 - October 31 & April 1 - April 15	Perform 5 Soil tests at 5 locations. Test and adjust to specified values. (see 3.02)
Pruning – Deciduous Trees	November 15 - March 1	Prune dead, weak, interfering, suckered, damaged or unsightly twigs/branches; remove street tree branches that penetrate the area 8 feet above finished grade of pedestrian surfaces; pruning shall not diminish the natural character of the tree. All pruning operations shall be supervised by the Contractor's New Jersey Licensed Tree Expert.
Pruning – Deciduous Shrubs	June 1 - August 1	Remove 1/3 of old wood; remove stems that overhang sidewalks and/or remove suckers. Prune forsythia immediately after flowering. Review pruning procedure with Engineer prior to pruning. All pruning operations shall be supervised by the Contractor's New Jersey Licensed Tree Expert.
Trimming – Hedges	May 15 - June 1 & July 15 - August 1	Shear to maintain shape & size shown on the Contract Drawings.

Function	Schedule	Description
Trimming – Perennials	Immediately after flowering	Remove all dead flowers & flower stalks & seed heads
	End of growing season for each individual bulb and perennial's requirements	Remove all dead leaves and cut plant stocks 6" from ground.
Anti-desiccant Winter Protection	December - February	Two separate applications to all plants
Mulching	January - December	Check once/month; maintain mulch layer as shown on the Contract Drawings.
Tree Staples	April 15th and October 15th	Inspect for frost heave or girdled roots and adjust or remover, as per recommendations of the Contractor's New Jersey Licensed Tree Expert.
	One year from time of installation	Remove completely.
New Jersey Certified Tree Expert's Walk Through Site Inspections	April – December	Twice per month.
	January – March	Once per month (Contractor's New Jersey LicensedTree.Expert's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "D"

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE DURING CONSTRUCTION (NEW JERSEY)

APPENDIX "E"

COMPOST – SOLUBLE SALTS LEVELS

Use the following table* to determine the maximum allowable ECe(dS/m of saturation extract) of compost at the desired application rate:

Desired Use Rate		Salinity (ECe) of On-Site Soil		
Cubic Yards Amendment per 1000 Sq. Ft. for incorporation to 6" depth	**Volume Percentage of Amendment**	**3 dS/m**	**2 dS/m**	**1 dS/m**
		Maximum ECe of Compost		
1	**5**	**14**	**28**	**42**
2	**11**	**7**	**14**	**21**
3	**16**	**5**	**9. 5**	**14**
4	**22**	**3. 5**	**7**	**10. 5**
5	**27**	**3**	**5. 5**	**8. 5**
6	**32**	**2. 5**	**4. 5**	**7**

Example: If Specification calls for 6 cubic yards compost per 1000/sq. ft. to be incorporated into the top 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding an ECe of 4 in the final blend, compost ECe should be less than 4.5 dS/m.

* This table is as per "Compost – A Guide for Evaluating and Using Compost Materials as Soil Amendments", by William Darlington, Soil & Plant Laboratory, Inc. as published by the University of California Extension Service, Orange County Office.

END OF APPENDIX "E"

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

February 28, 2013

ADDENDUM NO. 1

TO PROSPECTIVE BIDDERS ON CONTRACT **AKB-264.039** – BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOK

Page ii	Delete page ii in its entirety and substitute therefor revised page ii which is attached hereto and made a part hereof.
Page 4	Delete page 4 in its entirety and substitute therefor revised page 4 which is attached hereto and made a part hereof.
Pages 49 through 57	Following page 48, delete the first instance of pages 49 through 57 in their entireties and substitute therefor renumbered pages 48A through 48I (9 pages) which are attached hereto and made a part hereof.
Page 2754	Following page 2754, insert new page 2754A which is attached hereto and made a part hereof.

REVISED CONTRACT DRAWINGS

The electronic files of Drawing Nos. MT0406, MT0407, MT0408, MT0409, MT0411 and MT0421 have been revised as of 02/25/13. Copies of the electronic files of these drawings on a CD are forwarded herewith. Destroy the electronic files of these drawing numbers now in your possession and substitute therefor the revised electronic files.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:01

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

March 7, 2013

ADDENDUM NO. 2

TO PROSPECTIVE BIDDERS ON CONTRACT **AKB-264.039** – BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOK

Page 1 — In the second line of the first paragraph, change the day and date for receipt of Proposals to "Monday, April 15, 2013".

Page 10 — In the line for Available Document No. 22, delete "22." and substitute therefor "*22."

Page 10 — Immediately after the last LARSA MODEL INPUT FILE listed for Available Document No. 28, insert the following new lines:

"*29. AutoCAD 12 files entitled:

Strengthening Lower_Upper Chord Bracing

Composite of All Strengthened Members"

REVISED CONTRACT DRAWINGS

Drawing Nos. S3404 and S3614 have been revised as of 03/05/13. Copies of these drawings are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the revised drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:01
PROCUREMENT
(MAIL CENTER)

Contract Documents for BP-8 "Bayonne Approach Roadwork 3rd Street to 7th Street," 3/30/1931

Contract Documents for BP-9 "Port Richmond Approach Plaza Sections," 1/22/1931

Contract Documents for BP-10 "Paving, Railings & Miscellaneous Construction," 3/5/1931

Contract Documents for BP-11 "Port Richmond Approach & Trantor Place Approach," 7/2/1931

Contract Documents for BP-13 "Toll Buildings," 7/30/1931

REVISED CONTRACT DRAWINGS

Drawing Nos. S0303, S0503, S2002, S2005, and S2511 have been revised as of 03/08/13. Copies of these drawings are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the revised drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

If any elements are stored or located off the construction site, the Contractor shall also upon request deliver to the Authority a lease of or license to enter upon and use the real property where the elements are stored. Such lease shall be without cost to the Authority and in form and substance satisfactory to Authority.

If any elements are stored or located off the construction site, the Contractor agrees to accept responsibility for and to pay all sales, compensation, use, personal and property taxes that may be levied against the Authority by any state or subdivision thereof on account of such elements.

At the Engineer's request, the Contractor, at its expense, shall transfer title to any elements to be included in a monthly advance free and clear of and from all debts, claims, liens, mortgages, taxes and encumbrances by conveyance in form and substance satisfactory to the Authority.

Should any element paid for in part in any monthly advance subsequently become lost, damaged or unsatisfactory, the value of the element as determined by the Engineer shall be deducted from succeeding payments to the Contractor.

Page 214 — Immediately after the last sentence of clause "104. LAWS AND ORDINANCES", insert the following: "Approved permits will be provided to the Contractor upon receipt by the Authority. Work required to support additional requirements from Federal, State, and Local Authorities and outside entities, not shown on the Contract documents, will be compensated at the Net Cost thereof.".

Pages 1284 through 1289 — Delete pages 1284 through 1289 in their entireties and substitute therefor revised pages 1284 through 1289 which are attached hereto and made a part hereof.

REVISED CONTRACT DRAWING

Drawing No. S3704 has been revised as of 03/15/13. Copies of this drawing are forwarded herewith. Destroy the drawings (hard copy or electronic) of this number now in your possession and substitute therefor the revised drawing.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALED BY THE BIDDER:

2013 APR 17 PM 3:01
PROCUREMENT CENTER

forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the electronic files of the revised drawings.

NEW REFERENCE DRAWING

An electronic file of new Reference Drawing No. H-1040 added by this Addendum No. 5 and listed in the clause entitled Reference Drawings is included on the CD transmitting the revised Contract Drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:01
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E0501	2	3/29/2013	S1202	1	3/25/2013	S2221	1	3/26/2013
E0502	2	3/29/2013	S1203	1	3/25/2013	S2301	1	3/25/2013
E0503	2	3/29/2013	S1204	1	3/25/2013	S2404	1	3/8/2013
E0504	2	3/29/2013	S1205	1	3/25/2013	S2410	1	3/21/2013
E0507	2	3/29/2013	S1211	2	3/25/2013	S2442	1	3/21/2013
E0510	2	3/29/2013	S1213	2	3/25/2013	S2801	2	3/25/2013
E0611	2	3/29/2013	S1214	2	3/25/2013	S3148	1	3/25/2013
E0719	2	3/29/2013	S1216	2	3/25/2013	S3303	1	3/27/2013
E0733	1	3/29/2013	S1217	2	3/25/2013	S3541	1	3/26/2013
E0734	1	3/29/2013	S1219	2	3/25/2013	S3542	1	3/26/2013
E0736	2	3/29/2013	S1220	2	3/25/2013	S3543	1	3/26/2013
ES0406	1	3/26/2013	S1222	2	3/25/2013	S3544	1	3/26/2013
ES0413	1	3/26/2013	S1308	1	3/22/2013	S3545	1	3/26/2013
ES0420	1	3/26/2013	S1318	1	3/22/2013	S3546	1	3/26/2013
ES0428	1	3/26/2013	S1320	1	3/27/2013	S4312	1	3/26/2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

March 27, 2013

ADDENDUM NO. 8

TO PROSPECTIVE BIDDERS ON CONTRACT **AKB-264.039** – BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOK

Page 1 — *In the second line of the first paragraph, change the day and date for receipt of* Proposals to "Wednesday, April 17, 2013".

Note to Prospective Bidders: Addendum No. 7 will be issued shortly.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:02
PROCUREMENT
(MAIL CENTER)

work on the arch or on the new arch roadway shall not be performed over active traffic. See Contract Drawing G0203 for temporary structures notes.".

Page 1682 Delete only the text of 2.03A.3., and the text of subparagraphs a. through f., inclusive, of 2.03A.3. in their entireties, and substitute therefor "Not Used".

Page 1682 Delete only the text of 2.03B.2., and the text of subparagraphs a. and b., inclusive, of 2.03B.2., in their entireties, and substitute therefor "Not Used".

REVISED CONTRACT DRAWINGS

The following drawing numbers been revised as of the dates noted. Electronic files of these drawings contained on one CD are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the electronic files of the revised drawings.

Drawing No.	Rev. No.	Date	Drawing No.	Rev. No.	Date
E0736	3	4/2/2013	G0203	2	4/1/2013
ES0104	1	4/1/2013	MT0511	1	4/1/2013
ES0407	1	4/1/2013	S0330	1	3/29/2013
ES0408	1	4/1/2013	S0332	1	3/29/2013
ES0409	1	4/1/2013	S0334	1	3/29/2013
ES0410	1	4/1/2013	S0336	1	3/29/2013
ES0411	1	4/1/2013	S2408	1	3/27/2013
ES0412	1	4/1/2013	S2409	1	3/27/2013
FP0102	1	4/1/2013	S2420	1	3/27/2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:02
PROCUREMENT
(MAIL CENTER)

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

April 5, 2013

ADDENDUM NO. 10

TO PROSPECTIVE BIDDERS ON CONTRACT **AKB-264.039** – BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOK

Page 45 — Delete the page in its entirety and substitute therefor page 45 which is attached hereto and made a part hereof.

Page 1178 — In the first line of 2.01 A., delete "Sections 03301 and 03371" and substitute therefor "Section 03301".

REVISED CONTRACT DRAWINGS

The following drawing numbers been revised as of the dates noted. Electronic files of these drawings contained on one CD are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the electronic files of the revised drawings.

Drawing No.	Rev. No.	Date	Drawing No.	Rev. No.	Date
G0203	3	4/3/2013	S2222	1	4/4/2013
C0103	2	4/3/2013	S2301	2	4/4/2013
C0721	1	4/2/2013	S2605	1	4/4/2013
C0722	1	4/2/2013	S2606	2	4/4/2013
C0723	1	4/2/2013	S2608	2	4/4/2013
C0724	1	4/2/2013	S2610	1	4/4/2013
S0104	1	4/3/2013	S3614	3	4/2/2013
S1914	2	4/4/2013	S3618	1	4/1/2013
S2201	1	4/4/2013			

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

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damage to the cutting shoe, cutting teeth, or other casing tip reinforcement, or deformation of the casing.".

Page 558 — In the seventh through ninth lines of 3.02A11, delete "The device shall also be equipped with water jets to flush away any sediment that may exist and expose the rock socket sidewall and base." without substitution.

Page 565 — In the last line of Submittal B.12. after the word "shoes", insert ", cutting teeth, or other approved casing tip reinforcement, ".

Pages 1114 through 1164 — Delete pages 1114 through 1164 in their entireties and substitute revised pages 1114 through 1164B which are attached hereto and made a part hereof

REVISED CONTRACT DRAWINGS

The following drawing numbers been revised as of the dates noted. Electronic files of these drawings contained on one CD are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the electronic files of the revised drawings.

Drawing No.	Rev. No.	Date
S0201	2	4/8/2013
S0305	1	4/9/2013
S4025	1	4/9/2013
C0308	2	4/5/2013
ES0101	1	4/9/2013
ES0102	1	4/9/2013
ES0103	1	4/9/2013
ES0104	2	4/9/2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:02
PROCUREMENT
(MAIL CENTER)

REVISED CONTRACT DRAWINGS

The following drawing numbers been revised as of the dates noted. Electronic files of these drawings contained on one CD are forwarded herewith. Destroy the drawings (hard copy or electronic) of these numbers now in your possession and substitute therefor the electronic files of the revised drawings.

Drawing No.	Rev. No.	Date	Drawing No.	Rev. No.	Date
E0424	2	4/10/2013	S3110	1	4/4/2013
E0428	1	4/10/2013	S3112	1	4/4/2013
E0501	3	4/10/2013	S3113	1	4/4/2013
E0502	3	4/10/2013	S3142	1	4/4/2013
E0504	3	4/10/2013	S3144	1	4/4/2013
E0608	1	4/10/2013	S3308	1	4/10/2013
E0610	2	4/10/2013	S3519	1	4/4/2013
E0611	3	4/10/2013	S3520	1	4/4/2013
E0735	1	4/10/2013			

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

Pages 1200 and 1201	Delete Section 4.01 METHOD OF PAYMENT, including paragraphs A., B. and C., up to but not including the words "END OF SECTION" in their entireties without substitution.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

PROCUREMENT
(MAIL CENTER)
2013 APR 17 PM 3:02

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

April 15, 2013

ADDENDUM NO. 14

TO PROSPECTIVE BIDDERS ON CONTRACT **AKB-264.039** – BAYONNE BRIDGE – REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOK

Pages 46 through 48	Delete these pages in their entireties and physically attach in their place new pages 46 through 48 which are attached hereto and made a part hereof.
Pages 48A and 48A1	Delete these pages in their entireties and physically attach in their place new pages 48A and 48A1 which are attached hereto and made a part hereof.
Page 1175	Delete the text of 1.04A.1. in its entirety and substitute therefor: "Casting Concrete: Section 03301".
Page 1178	Immediately after the last sentence of 2.01A., insert the following new sentence: " Concrete for superstructure segments shall be self-consolidating.".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

2013 APR 17 PM 3:02
PROCUREMENT
(MAIL CENTER)

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

BID DATE 4/17/2013

SHEET 1

THIS IS NOT PART OF CONTRACT

CONTRACTOR Skanska Koch - Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
1	General Conditions	1	LS	105,000,000	105,000,000.
2	Self Launching Gantry System	1	LS	12,000,000.	12,000,000.
3	Maintenance of Traffic	1	LS	15,000,000.	15,000,000.
4	Civil Works				
5	Excavation and Disposal	116,000	CY	125.	14,500,000.
6	Granular And Structural Backfill	132,480	CY	50.	6,624,000.
7	Asphalt Concrete Pavement	7,530	TON	300	2,259,000.
8	Portland Cement Concrete Pavement	10,950	CY	450	4,927,500
9	Mechanically Stabilized Earth Retaining Wall including Moment Slab and Leveling Pad	38,880	SF	150	5,832,000.
10	Reinforced Concrete Pipes	1	LS	3,500,000	3,500,000.
11	Ductile Iron Pipes	1	LS	3,750,000	3,750,000.
12	RCP Box Detention Structure	1,100	LF	2,500.	2,750,000.
13	Catch Basins and Manholes	1	LS	2,000,000	2,000,000
14	Chain Link Fence And Arch Abutment Fence with Gates	15,065	LF	125.	1,883,125.
15	*All Remaining Civil Works*	1	LS	2,444,983.	2,444,983.
16	Structural Works				
17	Demolition Of Existing Toll Plaza	1	LS	100,000.	100,000.
18	Demolition Of Existing Pier and Abutments	22,000	CY	1,100.	24,200,000.
19	Demolition Of Existing Superstructure	1300	CY	10,000.	13,050,000.

PROCUREMENT (MAIL CENTER)

Revised: 3/26/2012

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

BID DATE 4/17/2013

SHEET 2

THIS IS NOT PART OF CONTRACT

CONTRACTOR Skanska - Koch - Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
20	Demolition Of Existing Approach Deck	10,000	CY	330.00	3,300,000.00
21	Demolition Of Existing Arch Floor Deck	64,000	SF	12.50	800,000.00
22	Demolition Of Existing Redundancy Girders on Arch	695	TON	1,500.00	1,042,500.00
23	Demolition Of Existing Sidewalk	39,600	SF	60.00	2,376,000.00
24	Reinforced Concrete For Temporary Deck	226	CY	2,100.00	474,600.00
25	Temporary Structural Support For Existing Substructure And Superstructure	1	LS	2,000,000.00	2,000,000.00
26	Temporary Suspenders	168	EA	45,000.00	7,560,000.00
27	Temporary Scuppers and Drainage Pipes	1	LS	250,000.00	250,000.00
28	Cofferdams	1	LS	4,500,000.00	4,500,000.00
29	Concrete For Footings, Abutments, Substructure And Superstructure	20,618	CY	700.00	14,432,600.00
30	Light Weight Concrete Deck For Arch Structure	5,520	CY	1,500.00	8,280,000.00
31	Epoxy Coated Reinforcing Rebar For Footings, Abutments, Substructure And Superstructure	4,677.47	TON	3,000.00	14,032,396.50
32	Stainless Steel Rebar For Superstructure And Arch Deck	3933.61	TON	1,200.00	4,720,331.40
33	Precast Concrete For Substructure	11,078	CY	1,700.00	18,832,600.00
34	Post Tensioning Steel For Substructure	430.5	TON	17,500.00	7,533,750.00
35	Precast Concrete For Superstructure	43,787	CY	1,800.00	78,816,600.00
36	Post Tensioning For Superstructure	1,624	TON	10,000.00	16,240,000.00
37	Grout For Post Tensioning And Supplemental Plates	1,075	CY	900.00	967,500.00
38	Structural Steel For Towers	1409	TON	5000.00	7,045,000.00

Revised: 3/26/2012

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

BID DATE 4/17/2013

SHEET 3

THIS IS NOT PART OF CONTRACT

CONTRACTOR Skanska Koch - Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions (1)	Quantity	Unit (2)	Unit Price	Amount
39	Structural Steel For New Arch Members Including Any Steel For Strengthening The Existing Members, Except for Structural Steel Specifically Identified in Other Units	987	TON	12,000.00	11,844,000.00
40	Structural Steel For Arch Truss Lattice Members Including New Members and Repairs	725	TON	6,500.00	4,712,500.00
41	Structural Steel For Arch Truss Cheese Plates Including New Members and Repairs	545	TON	6,500.00	3,542,500.00
42	Structural Steel For Edge Girders	1,093	TON	13,500.00	14,755,500.00
43	Structural Steel For Floor Beams	1789	TON	5000.00	8,945,000.00
44	Structural Steel For Stringers	1,112	TON	4,500.00	5,004,000.00
45	Structural Steel For Deck Flooring System Including Diaphragms And Wind Lateral Bracing Members	941	TON	5,500.00	5,175,500.00
46	Structural Steel For Blast Plates	1540	TON	5,500.00	8,470,000.00
47	Structural Steel Framing For Catwalk And Shared Use Path	356	TON	55,000.00	19,580,000.00
48	Structural Steel Repair Of Plates and Cheese Plates For Truss Lateral Bracing Gusset Plates	363	TON	9,000.00	3,267,000.00
48a	Structural Steel And Other Components For Permanent Suspenders	168	EA	550.00	92,400.00
49	Remove And Replace Lower Chord Suspender Anchorage	85	TON	1250.00	106,250.00
50	Pier Bearings on Approach Structures	168	EA	15,500.00	2,449,000.00
51	Expansion Joints on Approach Structures and Arch Structure	1	LS	4,000,000.00	4,000,000.00
52	Railing For Shared Use Path	3620	LF	40.00	144,800.00
53	Railing For Parapet and Catwalk	5610	LF	45.00	252,450.00
54	Catwalk Grating	6653	SF	16.50	109,774.50

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT **Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures**

BID DATE 4/17/2013

THIS IS NOT PART OF CONTRACT

SHEET 4

CONTRACTOR Skanska-Koch-Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
55	Structural Work Related To Administration Building, MEP Buildings, Tower Buildings and Storage Buildings	1	LS	5,300,000.00	5,300,000.00
56	All Remaining Structural Works	1	LS	11,000,000.00	11,000,000.00
57	Architectural Work	1	LS	2,500,000.00	2,500,000.00
58	Mechanical and Plumbing Works	1	LS	9,500,000.00	9,500,000.00
59	Fire Protection Work	1	LS	15,500,000.00	15,500,000.00
60	Electrical Works				
61	4" and 3" PVC Coated Rigid Galvanized Steel Conduit	1	LS	1,250,000.00	1,250,000.00
62	4" Rigid Galvanized Steel Conduit	9,000	LF	150.00	1,350,000.00
63	3" Rigid Galvanized Steel Conduit	60,000.00	LF	125.00	7,500,000.00
64	1/C #500 and #600 Kcmil XHHW	1	LS	3,500,000	3,500,000
65	Roadway and Bridge Lighting Works	1	LS	16,000,000	16,000,000
66	Temporary Staging And Maintenance Of Power Distribution	1	LS	300,000	300,000
67	Electrical Work Related To Administration Building, MEP Buildings, Tower Buildings and Storage Buildings	1	LS	11,000,000	11,000,000
68	All Remaining Electrical Works	1	LS	8,500,000	8,500,000
69	Electronics Work				
70	Temporary Work	1	LS	3,500,000	3,500,000
71	4" PVC Coated Rigid Galvanized Steel Conduit	1300	LF	275.00	357,500.00
72	All Remaining Electronics Conduit And Wiring	1	LS	5,000,000.00	5,000,000.00

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

BID DATE 4/17/2013

SHEET 5

THIS IS NOT PART OF CONTRACT

CONTRACTOR Skanska Koch-Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
73	All Work Related to AT&T and Verizon (Including Conduit and Cables)	1	LS	1,000,000	1,000,000.00
74	All Remaining Electronics Work	1	LS	11,000,000	11,000,000.00
75	SCADA System	1	LS	2,000,000.00	2,000,000.00
76	Temporary and Permanent Gantry System including Framing and Toll Equipment	1	LS	5,000,000.00	5,000,000.00
77	Environmental Work				
78	Lead Abatement, Abrasive Blast Cleaning and Repainting	660,154	SF	45.00	29706,930.00
79	Permanent Traffic				
80	F-Shaped Concrete Barrier	11,264	LF	850.00	9574400.00
81	All Remaining Permanent Traffic Works	1	LS	1,250,000.00	1,250,000.00
82	Intelligent Traffic System	1	LS	3,000,000.00	3,000,000.00
	Total Lump Sum =				670,063,990.00

PROCUREMENT
(MAIL CENTER)
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Revised: 3/26/2012

ANALYSIS OF BID (REVISED)

THE PORT AUTHORITY OF NY & NJ

PROJECT **Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures**

BID DATE 4/17/2013

THIS IS NOT PART OF CONTRACT

SHEET 6

CONTRACTOR Skanska - Kiewit JV

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount

1. Separate and list all items or operations of work included in your estimate in accordance with Specifications. When listing subcontracts, prime contractor will have each subcontractor complete an analysis of bid form.
2. Unit of measure, i.e., SF, CY, Bbls, Pcs, Ea., etc.
3. Include all charges, such as moving on site, removal, rental, etc.
4. In case of conflict between information hereon (whether supplied by Authority or the bidder) and terms or prices contained or inserted in Contract Booklet or Contract Drawings, said Booklet and Drawings shall control.
5. Analysis of Bid is not part of contract. No information hereon (whether supplied by Authority or the bidder) and no information deduced from information hereon, including quantities of materials or work, shall be deemed to vary, alter or modify any provision of Contract, including provisions rein as to compensation and performance. unit prices contained hereon serve sole purpose of informing Port Authority as to components of bidder's price quoted in Contract. items of materials or work contained hereon shall not deemed to be an exhaustive list of items of materials or work required by Contract Drawings and Specifications in their present form.

Revised: 3/26/2012

THE PORT AUTHORITY OF NY & NJ

CB06264039
PQL

F.F.
J.S.
HDR/PB, A Joint Venture

BAYONNE BRIDGE

BAYONNE BRIDGE - REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

CONTRACT AKB-264.039

Volume 2 of 3

APRIL 2013

This proposal is not complete unless bidder's Signature appears on page 29

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	DIVISION 15 – MECHANICAL
15310	SPRINKLER FIRE PROTECTION – PIPING AND APPURTENANCES
15312	ELECTRIC FIRE PUMPS AND ACCESSORY EQUIPMENT
15320	NOVEC 1230 SUPPRESSION SYSTEM
15375	FIRE STANDPIPE SYSTEM PIPING AND APPURTENANCES

SECTION	TITLE
15385	STANDPIPE EXPANSION JOINTS AND BALL JOINTS
15410	PLUMBING PIPING AND APPURTENANCES
15430	PLUMBING SPECIALTIES
15440	PLUMBING FIXTURES
15457	GAS-FIRED WATER HEATERS
15459	ELECTRIC WATER HEATERS
15488	NATURAL GAS PIPING AND APPURTENANCES
15491	PLUMBING INSULATION
15501	HVAC - PIPING AND APPURTENANCES
15502	REFRIGERANT PIPING AND APPURTENANCES
15503	FUEL OIL PIPING AND APPURTENANCES
15527	FLOW METERS
15705	HVAC EQUIPMENT
15731	COMPUTER ROOM AIR CONDITIONING UNITS
15855	AIR HANDLING UNITS
15860	CENTRIFUGAL FANS
15890	METAL DUCTWORK AND ACCESSORIES
15910	CONTROL SYSTEM FOR MECHANICAL EQUIPMENT SYSTEM
15931	AIR OUTLETS AND INLETS
15939	MOTORS AND MOTOR CONTROLLERS
15940	VIBRATION ISOLATION AND CONTROL
15945	HVAC INSULATION
15992	TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS
	DIVISION 16 – ELECTRICAL
16000	ELECTRICAL GENERAL REQUIREMENTS
16110	RACEWAYS
16114	CABLE TRAYS
16115	UNDERGROUND CONDUIT SYSTEMS
16120	WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)
16121	WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)
16127	CONTROL/SIGNAL TRANSMISSION MEDIA
16128	ARCPROOFING
16133	CONTROL PANELS, ENCLOSURES/CABINETS, AND TERMINAL BOXES

SECTION	TITLE
16135	BOXES AND FITTINGS
16140	WIRING DEVICES
16150	MOTOR POWER AND CONTROL WIRING
16190	SUPPORTING DEVICES
16250	TRANSFER SWITCHES
16320	DRY-TYPE TRANSFORMERS – GENERAL PURPOSE – 600 VOLTS OR LESS
16335	LOW VOLTAGE SWITCHGEAR
16390	ELECTRICAL POWER SYSTEM STUDIES
16450	GROUNDING
16452	BONDING
16470	PANELBOARDS
16475	OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)
16477	PROTECTIVE DEVICE COORDINATION STUDY
16510	LIGHTING SYSTEMS
16512	COLOR CHANGING LIGHTING SYSTEM
16514	LIGHTING SYSTEM MOD
16550	ROADWAY LIGHTING
16611	SOLID STATE UNITERUPTIBLE POWER SUPPLY
16620	DIESEL-GENERATOR SET (WITH AUXILIARIES)
16670	LIGHTNING PROTECTION SYSTEM
16721	FIRE ALARM SYSTEM EQUIPMENT
16728	ELECTRONIC EQUIPMENT RACKS AND COMMUNICATION CABIN
16729	FIBER OPTIC CABLE
16745	DATA NETWORK EQUIPMENT
16790	ROAD EMERGENCY TELEPHONE SYSTEM
16792	INTELLIGENT TRANSPORATION SYSTEM DEVICES
16793	FURNISH AND INSTALL MICROWAVE SENSOR ASSEMBLY
16858	ELECTRIC HEATING CABLES
16859	ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)
16860	ELECTRIC HEATERS
16936	SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

Figure 1 Noise Sensitive Zones

Schedule of Minimum Wage Rates (FED NJ)
Schedule of Minimum Wage Rates (FED NY)
Notification of M/WBE On-line Directory and Forms
Schedule A
Schedule B
Schedule C
Schedule D
Analysis of Bid

DIVISION 3

SECTION 03052

EPOXY JOINTING OF PRECAST SEGMENTS

PART 1. GENERAL

1.01 SUMMARY

A. This Section and its appendices specify requirements for furnishing, mixing and applying a two-component epoxy bonding system to the match cast faces of joints between precast concrete superstructure and/or substructure segments in accordance with the Contract Drawings.

B. In its workable state, or open time, the epoxy bonding agent must function as a lubricant for joining the segments. In its hardened state, the epoxy bonding agent must provide a watertight seal between the precast concrete segments. The hardened epoxy bonding agent must provide intimate contact for stress transfer by completely filling all interstitial space between the match cast segment faces.

C. This Section applies to precast segmental structures with multiple shear joints in webs and joints with suitable shear keys in precast substructure segments.

1. Do not use slow set epoxy without the written approval of the Engineer.

1.02 REFERENCES

The following is a listing of the publications, standards and codes referenced in this Section, of which the latest edition shall govern:

ASTM International (ASTM)

ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics

1.03 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements

1. If electing to erect segments in cold weather when the substrate temperature of the mating concrete surfaces is below 40 deg F, an artificial environment may be used to increase the substrate temperature subject to the following:

   a. Make the artificial environment by an enclosure surrounding the joint through which warm air is circulated, or heating is provided by radiant heaters.

   b. Raise the temperature of the concrete substrate across the entire joint surface to at least 40°F.

   c. Prevent localized heating and the temperature of the substrate exceeding 95 deg F at any point on the surface. Direct flame heating of the concrete is not allowed.

d. Maintain the temperature of the substrate surfaces between 40 deg F and 95 deg F for at least 24 hours after joining the surfaces.

e. The Contractor may propose, for review by the Engineer, an optional method of raising and maintaining the substrate temperature of the mating surfaces. Any optional method must meet the thermal restrictions above.

2. Epoxy jointing operations may proceed if the air temperature is above 45 deg F and rising and the limitations above are met.

B. Hot Weather Requirements: If the substrate temperature exceeds 115 deg F, do not proceed with epoxy jointing. The Contractor may take precautions to keep the mating substrate surfaces cool by shading and/or wetting with clean water except that the requirements for no moisture at the time of application must be strictly adhered to.

1.04 DELIVERY, STORAGE AND HANDLING

A. Epoxy Materials - Packaging, Labeling, and Safety:

1. Use only components packaged in two parts, in sealed containers, proportioned in the proper reacting ratio, ready for combining and mixing in accordance with the manufacturer's instructions.

a. Each container must bear a label and/or stamp designating:

(1) manufacturer's name,

(2) brand name,

(3) component type (resin or hardener),

(4) range of substrate (surface of concrete) temperature over which the application is suitable,

(5) material classification,

(6) date of formulation,

(7) shelf life of the material,

(8) manufacturer's lot number,

(9) prominently display mix ratios on labels,

(10) State potential hazards on each package in accordance with the Federal Hazardous Products Labeling Act.

b. Provide instructions, furnished by the manufacturer, for the safe storage, handling, mixing and application of the material. Do not use any material from containers which are damaged or have been previously opened. Combining of epoxy bonding components from bulk supplies will not be permitted. Only full packets of components will be mixed.

2. Epoxy materials which have been in storage for more than 12 months will not be accepted for use.

1.05 QUALITY CONTROL

A. General

1. Maintain a level of Quality Control sufficient to consistently achieve the end result performance properties specified herein.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

B. Do not commence epoxy jointing operations until all approvals have been obtained.

PART 2. PRODUCTS

2.01 MANUFACTURERS AND SOURCES OF SUPPLY

A. Supply segment epoxy jointing compounds from one of the following, or approved equal:

1. BASF C Building Systems (Shakopee, MN)
2. Euclid Chemical (Cleveland, OH)
3. Pilgrim Permocoat, Inc. (Tampa, FL)
4. Sika Corporation (Bradenton, FL)

2.02 MATERIALS

A. General: Use only epoxy bonding agents for match-cast joints between precast segments which are thermosetting, 100% solid compositions that do not contain solvent or any non-reactive organic ingredient except for pigment required for coloring and meet the requirements of ASTM C881, Type VI Grade 3 as modified below.

1. Use epoxy-bonding agents composed of two components, a resin and a hardener, with each component distinctly pigmented so that mixing produces a third color similar to the concrete in the segments.
2. Epoxy bonding agents must be insensitive to damp conditions during application and, after curing, must exhibit high bonding strength to cured concrete, good water resistivity, low creep characteristics and tensile strength greater than the concrete.

B. Classification of Epoxy Material

1. Epoxy bonding agents which remain workable for a short open time (about one hour) are referred to herein as "normal set epoxy".
2. Epoxy bonding agents which remain workable over an extended open time (about eight hours) are referred to herein as "slow set epoxy".

C. Formulation for Temperature Range: Epoxy bonding agents must be formulated to provide application temperature ranges which are suitable for the erection of match cast segments with substrate temperatures between 40 deg F and 115 deg F with a minimum of at least two, but preferably three, formulations dividing the range into approximately equal sub-ranges which overlap by at least 5 deg F.

D. Physical Requirements:

1. General: Epoxy bonding agents proportioned as designated by the manufacturer and mixed in accordance with the manufacturer's recommendations shall meet the requirements of ASTM C881. For the properties listed below, modify the ASTM test procedures as noted. The components of the epoxy-bonding agent shall be conditioned to the temperature at which testing is to be done prior to mixing the test specimen.
2. Contact Time (Open Time) and Contact Strength: The contact time (open time) of the mixed epoxy-bonding agent shall be:

a.	Normal-Set Epoxy	60 minutes, minimum
b.	Slow-Set Epoxy	6 hours, minimum

c. The above contact time (open time) will be deemed acceptable if a slant cylinder test specimen, prepared and tested in accordance with the conditions below, sustains the following stress (contact strength) on the slant plane calculated as the axial (vertical) load divided by the area of the slant ellipse:

(1) Normal -Set Epoxy 1,000 psi at 48 hours after joining

(2) Slow-Set Epoxy 1,000 psi at 14 days after joining

d. The cement mortar/concrete material for the slant-cylinder test shall have a compressive strength of at least 4,500 psi at 28 days when tested to ASTM C39. The slant-cylinder test procedure shall be in accordance with ASTM C882 with the following modifications:

(1) Delay joining of the sloped surfaces for the following period of time, measured from the time the epoxy was mixed:

(a.) Normal -Set Epoxy 60 minutes

(b.) Slow-Set Epoxy 6 hours

(2) During the period between mixing of the epoxy and joining of the sloped surfaces, the specimens will be uncovered and maintained at the maximum temperature of the application range for the formulation tested.

(3) After joining, cure at the maximum temperature of the formulation range at the time periods specified above prior to testing.

(4) For slow-set epoxy, prepare an additional test specimen and test it to failure at 36 hours. The formulation of the slow-set epoxy is acceptable only if the epoxy¬ bonding agent exhibits a brittle break.

3. Compressive Yield Strength: The compressive yield strength of the epoxy-bonding agent shall be:

a. Normal-Set Epoxy 2,000 psi at 24 hours
10,000 psi at 48 hours

b. Slow-Set Epoxy 2,000 psi at 7 days
10,000 psi at 14 days

c. Determine compressive yield strength in accordance with ASTM D695 with the following conditions:

(1) Pour the epoxy-bonding agent into the mold for forming specimens within ten minutes after starting mixing of the components.

(2) Prior to testing, cure the specimens at the minimum temperature of the formulation range for the time periods specified above.

4. Bond Strength: Bond strength shall be:

a. Normal-Set Epoxy 1,000 psi at 48 hours after joining

b. Slow-Set Epoxy 1,000 psi at 14 days after joining

c. Determine the bond strength in accordance with ASTM C882 with the following modifications:

(1) The test cylinder of concrete shall have a compressive strength of at least 6,000 psi at seven days age.

(2) Delay joining of the sloped surfaces for the following period of time, measured from the time the epoxy was mixed:

(a.) Normal-Set Epoxy 60 minutes

(b.) Slow-Set Epoxy 6 hours

(3) During the period between mixing of the epoxy and joining of the sloped surfaces, the specimens will be uncovered and maintained at the minimum temperature of the application range for the formulation tested.

(4) After joining, cure at the minimum temperature of the formulation range for the time periods specified above prior to testing.

2.03 QUALITY ASSURANCE

A. Qualifications of Contractor's Personnel

1. For mixing, handling and applying the epoxy bonding agent, provide direct supervision by a person with knowledge and experience, or trained by a technical representative of the manufacturer in the use of this material. Arrange for a technical representative of the manufacturer to be at the site as an advisor at the beginning of this work.
2. All personnel who will be working with the epoxy bonding agent shall be thoroughly familiar with the safety precautions necessary for use of this material.
3. Develop mixes to meet the following performance criteria Quality Acceptance Limits in accordance with the relevant application properties specified in 4.01.B., Table 2, unless otherwise noted on the Contract Drawings.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. Cleanliness of Surfaces to be Joined: Ensure that the application surfaces are free from oil, form release agent, laitance or any other deleterious material that would prevent the epoxy bonding agent from bonding to the concrete surface. Remove laitance by light sandblasting, wire brushing. Do not destroy the surface shape and profile of the mating surfaces. The surfaces shall have no free moisture on them at the time the epoxy bonding agent is applied. Free moisture will be considered present if a dry rag, after being wiped over the surface, becomes damp.

B. Substrate Temperatures and Epoxy Formulation: Apply the epoxy bonding agent only when the substrate temperature of both surfaces to be joined is between 40 deg F and115 deg F. The formulation of the epoxy bonding agent must have an application temperature range that conforms to the substrate temperature of the surfaces being joined.

1. If the mating surfaces have different substrate temperatures, then use the formulation for the higher temperature in hot weather periods. In cold weather periods, use the formulation for the lower temperature.

3.02 CONSTRUCTION REQUIREMENTS

A. Apply an epoxy bonding agent meeting the requirements of this Section to mating surfaces of all match-cast precast concrete segments.

B. Have the necessary cleaning materials immediately available at the location of the segment joining, in the event that the segments must be separated and cleaned or epoxy reapplied.

C. Include in the erection manual required by Section 03432, details of erection and post-tensioning operations which assure that the time elapsing between mixing components of the first batch of epoxy bonding agent applied to the joining surfaces of precast concrete segments and the application of a compressive contact pressure across the joint does not exceed 70% of the open time for the particular formulation of epoxy bonding agent used.

1. Also, include details of how the minimum, closing, contact pressure of approximately 40 psi will be applied uniformly to each joint to which epoxy is applied during the epoxy curing period. Contact pressure may be attained through combinations of weight and temporary and/or permanent post-tensioning.

3.03 MIXING OF EPOXY BONDING AGENT

A. Mix the two components of the epoxy bonding agent in strict accordance with the manufacturer's instructions, using only full and undamaged containers. Only open the containers immediately before being combined and do not use any which have an expired shelf life. Thoroughly stir each container of component before combining the components. Combine the two components and thoroughly mix until a uniform color is achieved. Mix with a properly sized mechanical mixer operating at no more than 600 rpm and/or in accordance with the recommendations of the epoxy manufacturer.

B. Do not mix until the segments to be joined are within approximately 18 inches of their final position. Schedule mixing of the epoxy bonding agent so that the material in a batch is applied to the face of a joint within a maximum of 20 minutes after combining the components.

C. The Engineer, at his discretion, may require a dry run to check the fit of two surfaces before applying the epoxy.

3.04 APPLICATION AND AMOUNT OF EPOXY

A. Begin application immediately after a batch has been mixed. Uniformly apply the epoxy bonding agent in accordance with the manufacturer's recommendations by spatula or gloved hand a nominal thickness of 1/16 inches.

1. Apply the epoxy to all areas of both faces to be joined. Do not exclude epoxy from around holes formed by ducts.
2. Apply additional epoxy thickness, equal to the shim thickness, to segment faces when shims are placed in a joint.

B. The amount of epoxy may be adjusted provided that a sufficient amount is applied to completely fill all interstitial space in the joint and to extrude a small bead from the joint after application of the compressive contact pressure.

1. If a bead of epoxy is not extruded all around the joint, then determine the reason why before proceeding. Do not use an epoxy bonding agent from a batch for which the time since combining the components has exceeded 20 minutes.

3.05 MATING OF SEGMENTS

A. Immediately after each mating surface is covered with epoxy bonding agent, bring the segments together and apply the specified compressive contact pressure in accordance with the approved erection procedures. The contact pressure may be increased at any time after the epoxy has taken an initial set. Do not reduce the contact pressure until the epoxy in the joint has properly hardened and cured. If the contact pressure is reduced, do not subject the joint to tensile stress.

B. A discernible bead line of extruded epoxy bonding agent must be apparent along the exposed edges of the joint. Fill all areas of the joint which do not show a bead of epoxy by dispensing additional epoxy, meeting the requirements of this specification, into the joint using a pneumatic gun with epoxy cartridges. Inject epoxy to a minimum depth of 1 inch.

C. Catch and retain epoxy which is squeezed out of the joint in areas over waterways, roadways, buildings, etc.

D. Clean all extruded epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface. Do not smear surplus extruded epoxy bonding agent over large areas (areas more than 1 inch from each side of the joint) that are visible surfaces.

E. Immediately after the segments are joined, swab all embedded (internal) post-tensioning ducts or conduits passing through the joints to smooth out any extruded epoxy bonding agent.

1. If the time between combining the components of the epoxy bonding agent and applying the compressive contact pressure exceeds 70% of the minimum open time, immediately separate the segments and clean in accordance with the following.

F. Failure to Comply with Time Limits or Incomplete Jointing: If the time limit between mixing of the epoxy bonding agent and the application of the contact pressure is exceeded, or if the joint is incompletely filled and sealed, separate the segments and remove all epoxy from the faces using spatulas and approved solvent.

1. Do not re-apply epoxy until the faces have been properly cleaned and solvents dispersed, for a period of 24 hours.

3.06 REMOVAL OF SUPPORT TO SEGMENTS

A. Cantilever Erection: Independent support to a newly erected cantilever segment may be removed when the epoxy bonding agent in the third previous mating joint has set.

1. It is not necessary for the epoxy bonding agent in the new joint or the immediately previous joint to be set prior to removing the independent support of the new segment provided that the temporary and/or permanent post-tensioning has been installed to carry the load of the new and previous segment along with any applied construction loading as per the requirements of the erection system.

3.07 RECORD OF JOINTING

A. Record and submit to the Engineer on a weekly basis the following information:

1. General:
   a. Date and time of jointing,
   b. Segment numbers or spans jointed,
   c. Weather conditions
2. For each joint (identified by location or segment numbers):
   a. Manufacturer's lot number of epoxy bonding agent components.
   b. Temperature of the concrete on the joint surface at the middle of each segment when application of the epoxy bonding agent began.
   c. Time of mixing first batch of epoxy bonding agent applied to the joint and completion of application. d) Time of applying the required compressive contact pressure.
3. Details of any repairs performed including reason for repair, joint location, volume of epoxy used, and method of application.

END OF SECTION

SECTION 03052

EPOXY JOINTING OF PRECAST SEGMENTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts, Material Certification and Test Results

1. Provide documentation for the temperature ranges and types (fast or slow) of the epoxy compound proposed for use on the project at least 35 calendar days prior to first use of the epoxy. Include:

   a. Name and address of proposed manufacturer.

   b. Material certifications, source, brand name and test results.

B. Samples

1. Provide one can of each component for each temperature range and type proposed for use on the project. Deliver samples to the Authority's Materials Engineering Unit office. Provide the samples at least 60 calendar days prior to first use of the epoxy.

C. Construction Procedures and Quality Control Documents and Plans

1. At least 35 calendar days prior to first use, provide the following:

   a. Mixing and placement procedures

      (1) Methods of proportioning

   b. Safety precautions

END OF APPENDIX "A"

DIVISION 3

SECTION 03100

CONCRETE FORMWORK

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for cast-in-place concrete formwork.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Concrete Institute (ACI)

ACI 347	Guide to Formwork for Concrete
ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM D 1751	Specification for Preformed Expansion-Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)

National Forest Products Association (NFPA)

National Design Specifications for Wood Construction

West Coast Lumber Inspection Bureau

American Plywood Association (APA)

Douglas Fir Plywood Association (DFPA)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design calculations shall be prepared by a Professional Engineer licensed in the State where the Work is to be performed. Design calculations shall be made available to the Engineer to facilitate inspection.

B. For wood products furnished for the Work of this Section, the Contractor shall comply with the applicable provisions of "National Design Specifications for Wood Construction" of the National Forest Products Association (NFPA).

C. For all other products furnished for the Work of this section, the contractor shall comply with the reference standards of the local building code.

D. Shop Drawings

1. All formwork and shoring shop drawings shall be signed and sealed by a Professional Engineer licensed in the State where the Work is to be performed. Shop drawings shall be made available to the Engineer to facilitate inspection.

2. Shop drawings shall indicate:

a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports;

b. Means of leakage prevention for concrete exposed to view in the finished construction;

c. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift and height of drop during placement;

d. Vertical, horizontal and special loads in accordance with "Loads" of ACI 347 (Section 2.2) and camber diagrams, if applicable;

e. Notes to formwork erector showing size and location of conduits and pipes embedded in concrete according to ACI 318 (Section 6.3).

1.04 SUBMITTALS

For Submittals - see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS.

A. Earth Forms

Use only for footings where shown on the Contract Drawings.

B. Lumber Forms

Use for edge forms and unexposed finish concrete. Boards shall be 6 inches or 8 inches in width, shiplapped or tongue and groove, "Standard" Grade Douglas Fir, conforming to the "Standard Grading and Dressing Rules No. 17", of the West Coast Lumber Inspection Bureau. Boards shall be four sides surfaced.

C. Plywood Forms

Use for exposed finish concrete. Forms shall conform to U.S. Product Standard PA 1-66. Each panel shall carry the grade trademark of the American Plywood Association along with the Douglas Fir Plywood Association (DFPA) Quality stamp and shall be full size (4-foot x 8-foot) panels.

1. Plywood for surfaces to receive membrane waterproofing shall be a minimum of 5/8 inch thick and shall be "B-B Plyform Class 1 Exterior" grade.

2. Plywood where "Smooth Finish" is required, as shown on the Contract Drawings, shall be "HD Overlay Plyform Class 1 Exterior" grade, a minimum of 3/4 inch thick.

D. Prefabricated Forms

Prefabricated forms shall be as listed below and where shown on the Contract Drawings:

1. Pan Type Void Forms

   Removable steel or reinforced plastic of sizes and profiles required to produce completed Work shown.

2. Tubular Column Type

   Metal, fiberglass-reinforced plastic, or spirally wound laminated fiber materials; inside surface treated with release agent; of sizes required to produce completed Work shown.

E. Steel Forms

Sheet steel, suitably reinforced and designed for the particular use shown on the Contract Drawings.

F. Form Liners

Smooth, durable, grainless and non-staining hardboard, unless otherwise shown on the Contract Drawings.

G. *Framing, Studding, and Bracing*

Stud or No. 3 Structural Light Framing grade.

H. Form Ties and Spreaders

Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. No wire ties, wood spreaders or through bolts will be permitted.

I. Form Anchors and Hangers

Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.

J. Form Coating Agent

Provide one of the following unless otherwise shown on the Contract Drawings:

1. "Arcal-80"; Arcal Chemical Corporation
2. "Synthex"; Industrial Synthetics Company
3. "Nox-Crete Form Coating"; Nox-Crete Company

K. Vapor Retarder

Where shown on the Contract Drawings, 8 mil thick poly-ethylene sheet

L. Bituminous Joint Filler: ASTM D 1751

PART 3. EXECUTION

3.01 PREPARATION

A. Earth Forms

Trench earth forms neatly and accurately and at least 2 inches wider than footing widths shown on the Contract Drawings, unless otherwise indicated. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing. Form sides of footings where earth sloughs. Earth forms shall be tamped firm and cleaned of all debris and loose material before depositing concrete.

B. Formwork – General

Sloped surfaces steeper than 1.5 horizontal to 1 vertical should be provided with a top form to hold the shape of the concrete during placement, unless it can be demonstrated to the engineer that top forms can be omitted. Construct forms to the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials or the placing and vibrating of the concrete shall not throw them out of line or position. Forms shall be strong enough to maintain their shape under all imposed loads. Camber where necessary to assure level finished soffits unless otherwise shown on the Contract Drawings. Carefully verify the horizontal and vertical positions of forms and correct all inaccuracies to the satisfaction of the Engineer before placing concrete in any form. Complete all wedging and bracing before placing concrete.

C. Forms for "Smooth Finish" Concrete

Use steel, plywood or lined board forms. Plywood and form liners shall be clean, smooth, uniform in size and free from damaged edges and holes. Form lining shall have close-fitting square joints between separate sheets and shall not be sprung into place. Sheets of form liners and plywood shall be full size wherever possible and joints shall be taped to prevent protrusions in concrete. Use special care in forming and stripping wood forms to protect corners and edges. All horizontal joints shall be level and continuous. Wood forms shall be kept wet at all times until stripping.

D. Forms for Surfaces to Receive Membrane Waterproofing

Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding and Bracing

Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood. Framing, bracing, centering and supporting members shall be of ample size and strength to carry safely, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Soffits of all beam forms shall be constructed of material a minimum of two inches thick. Concrete out of line, level or plumb will be cause for rejection by the Engineer of the whole Work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining, settlement or accidental impact.

3.02 INSTALLATION

A. Tolerances

Formwork shall be constructed so that concrete surfaces shall be within construction tolerances specified in "Standard Specifications for Tolerance for Concrete Construction and Materials" of ACI 117. Tolerances not met will be corrected to the satisfaction of the Engineer at no cost to the Authority.

B. Chamfered Corners

As shown on the Contract Drawings, provide moldings in forms for all chamfering required. Moldings shall be 45-degree right triangles in profile, of size required, milled from wood free from visible defects.

C. Forms Ties

Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Place ties at least one inch away from the finished surface of the concrete. Leave inner rods in concrete when forms are stripped. Space all form ties to be equidistant, and symmetrical and lined up both vertically and horizontally unless otherwise shown on the Contract Drawings.

D. Cleanouts and Access Panels

Provide removable cleanout sections or access panels at the bottoms of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. Clean all forms and surfaces against which concrete is to be placed of all chips, sawdust, and other debris and thoroughly blow out with compressed air just before concrete is placed.

E. Arrangement

Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

F. Construction Joints

Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide a straight line at joints. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no overlapping of concrete and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true, and sharp.

G. Embedded Items

Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops and other features. No wood or uncoated aluminum shall be embedded in concrete. Obtain any required information pertaining to embedded items to be furnished for the Work specified in other Sections. Securely anchor all embedded items in correct location and alignment prior to placing concrete. Conduits and pipes, including those made of coated aluminum, must meet the requirements of ACI 318 (Section 6.3). Approved coatings for aluminum shall be as follows unless otherwise shown on the Contract Drawings:

1. Conlux

   Primer - Bond Plex 46 or 66 (water borne urethane)
   Topcoat - Epolon Multi-Mil 39 (epoxy polyamide)

2. Sherwin Williams

   Topcoat - Heavy Duty Epoxy B67/B60B3 (epoxy polyamide)
   Note: self-priming

3. Benjamin Moore

   Primer - Epoxy Rust Inhibitive Primer (epoxy polyamide)
   Topcoat - Epoxy Enamel (epoxy polyamide)

H. Openings for Items Passing Through Concrete

Frame openings in concrete where shown on the Contract Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections. Coordinate all Work of this nature in order that there shall be no unnecessary cutting and patching of concrete. Perform any cutting and repairing of concrete required as a result of failure to provide for such openings at no cost to the Authority.

I. Screeds

Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs. Slope slabs to drain where required or as shown on the Contract Drawings. Before depositing concrete, remove all debris from the space to be occupied by the concrete and thoroughly wet all forms. Remove freestanding water.

J. Screed Supports

For concrete over waterproof membranes and vapor barrier membranes, use screed supports of a cradle, pad or base type which shall not puncture the membrane. Staking through the membrane will not be permitted.

K. Shores and Falsework

Provide shores and falsework of adequate strength to protect persons and adjacent structures. Falsework and supports shall be adequate in size and strength to resist the loads imposed upon them without deformation, deflection, or settlement. All members must be straight and true without twists or bends. Use wedges in pairs or jacks where required to bring forms, shoring, or falsework for beams, girders, slabs, and other parts of the structure to the necessary elevations and uniform bearing before placing concrete. Do not use single wedges. Vertical and lateral loads shall be carried to ground by the formwork system or by bracing. Where shores rest on ground, provide adequate mud sills or other bases. Construct forms to permit their removal without disturbing the original shoring. Ensure that there is no movement of shores, braces or other supports during placement of concrete.

L. Reuse and Coating of Forms

Thoroughly clean forms and reapply form coating before each reuse. For exposed Work, do not reuse any form which cannot be reconditioned to "like new" condition. Discard forms considered unsatisfactory by the Engineer. Apply form coating to all forms in accordance with the manufacturer's specifications, except where "Scored Finish" is required as shown on the Contract Drawings. Do not coat forms for concrete that is to receive a "Scored Finish". Apply form coatings before placing reinforcing steel.

M. Inspection

Notify the Engineer after placement of reinforcing steel in the forms, but prior to placing any concrete, so that his inspection may be made.

3.03 REMOVAL OF FORMS AND SHORES

A. The forms and supporting shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed thereon safely and until the time and sequence of removal have been approved by the Engineer. Formwork shall be removed without damage to the concrete, in a sequence that does not allow the members to be subject to impact or loading eccentricities. Any repair required as a result of damage to the concrete shall be made to the satisfaction of the Engineer at no cost to the Authority.

B. Except when otherwise approved by the Engineer, or when minimum attained concrete strengths are specified on the Contract Drawings, forms shall be left in place for not less than the total number of days as specified in ACI 347.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

03100A01 From work and shoring shop drawings for areas accessible to the public and/or concrete exposed to view in the finished construction shall be submitted to the Engineer (as indicated in Section 1.03 D) at least 21 days prior to ordering any material or constructing any formwork.

03100A02 Provide a layout of all embedded items, including electrical and telephoneconduit and lumbing and drainage pipes, at least 15 days prior to concrete placement.

Catalog Cuts

03100B01 Material certifications, brand names and test results (where required) for all formwork materials. Submit at least 35 days prior to concrete placement.

Samples

03100C01 From ties and spreaders with manufacturer's specifications, submit at least 21 days prior to ordering any material.

03100C02 Tapes for form joints with manufacturer's literature;

03100C03 Water stops and premolded expansion joint filler;

03100C04 From liners with manufacturer's specifications, submit at least 21 days prior to ordering any material;

03100C05 From coating agent with manufacturer's literature

Calculations

03100H01 Design computations for areas accessible to the public and/or concrete exposed to view in the finished construction shall be submitted to the Engineer (as indicated in Section 1.03 A)

at least 21 days prior to ordering any material or constructing any formwork.

END OF APPENDIX "A"

DIVISION 3

SECTION 03200

CONCRETE REINFORCEMENT

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for furnishing and installing concrete reinforcement.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M32	Steel Wire, Plain, for Concrete Reinforcement
AASHTO M55	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
AASHTO M221	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
AASHTO M31	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO M284	Epoxy-Coated Reinforcing Steel Bars

American Concrete Institute (ACI)

ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 276	Stainless Steel Bars and Shapes
ASTM A 380	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A 497	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 767	Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775	Epoxy-Coated Reinforcing Steel Bars

American Welding Society (AWS)

AWS D 1.4	Structural Welding Code - Reinforcing Steel

Concrete Reinforcing Steel Institute (CRSI)

Manual of Standard Practice Placing Reinforcing Bars

1.03 BRIDGE WORK

For Work of this Section involving bridges, the Contractor shall comply with the applicable provisions of "Standard Specifications for Highway Bridges" of the American Association of State Highway and Transportation Officials (AASHTO). Materials shall be in accordance with AASHTO designations where shown after the ASTM designation in parenthesis. Where not shown, comply with ASTM Designation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver concrete reinforcement in bundles marked with metal tags indicating size, length and mark number.

B. Store and handle materials to prevent corrosion, damage to coating or contamination that could impair bond.

C. Deliver, store, and handle stainless steel reinforcing bars to ensure the surface is free of contaminants including deposits of iron and non-stainless steel, and damage due to straightening from coil.

1.05 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: ASTM A 615 (AASHTO M31), deformed, Grade 60, unless otherwise shown herein or on the Contract Drawings.

Coated bars where shown on the Contract Drawings shall comply with the following:

1. Galvanized Reinforcing Bars

ASTM A 767, Class-I hot-dip galvanized, after fabrication and bending.

Repair sheared and cut ends and damaged coating with a zinc-rich formulation conforming to ASTM A 767 in accordance with the material manufacturers' recommendations.

2. Epoxy-coated Reinforcing Bars: ASTM A 775 (AASHTO M284)

Repair sheared and cut ends and damaged coating with an epoxy patching material conforming to ASTM A 775 (AASHTO M284) in accordance with the patching material manufacturers recommendations.

3. Stainless Steel Reinforcing Bars: ASTM A276

All stainless steel reinforcing bars shall conform to ASTM A955 grade 75; and shall meet the requirements of ASTM A276 Type 2304 (UNS S32304), no substitutions.

B. Welded Wire Fabric

Types shall be as shown on the Contract Drawings and shall comply with the following:

1. Plain, ASTM A 185 (AASHTO M55), flat sheets for size W5 and larger and coiled rolls for sizes below W5.

2. Deformed, ASTM A 497 (AASHTO M221), flat sheets for sizes D5 and larger and coiled rolls for sizes below D5.

3. Epoxy coated ASTM A884 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

C. Fabricated Steel Bar Mats

Fabricated steel bar mats shall be in accordance with ASTM A 184, when shown on the Contract Drawings, and as follows:

1 Bar grade, size and spacing as shown on the Contract Drawings.

2 Welded connections, unless otherwise shown on the Contract Drawings.

D. Steel Wire

Steel wire shall comply with ASTM A 82 (AASHTO M32), plain finish, unless otherwise shown on the Contract Drawings.

2.02 ACCESSORIES

A. Tie Wire

1. Provide minimum 16-gage, annealed type. Provide nylon, plastic or epoxy-coated wire for use with epoxy-coated and galvanized reinforcing bars, if any.

2. Tie wire used to tie stainless steel reinforcement shall be annealed 16 or 18 gauge wire fabricated from stainless steel alloy UNS S31600.

B. Supports for Reinforcement

Provide bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use galvanized steel wire bar type supports complying with CRSI standards and as follows:

1 For supporting epoxy-coated reinforcing bars, use plastic coated supports, or supports

fabricated from or coated with a dielectric material.

2 For slabs-on-grade, use supports with horizontal plate runners.

3 For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, use supports with plastic capped legs (CRSI, Class 1).

4 Where architectural concrete is shown on the Contract Drawings, use plastic side form spacers.

5 Place all stainless steel reinforcement on bar chairs that are solid plastic, stainless steel or concrete with stainless tie wire implanted in the concrete chair. Fabricate stainless steel metal chairs and continuous metal stainless steel supports from stainless steel conforming to the requirements of ASTM A 493, UNS S31600, or UNS S31603. Stainless steel chairs used above steel beams shall have plastic coated feet.

2.03 FABRICATION

A. Fabricate concrete reinforcement as shown on the Contract Drawings and on approved shop drawings, in accordance with ACI 315 "Tolerances".

B. Bend all concrete reinforcement cold. Heating of bars or wire fabric is prohibited.

C. Where welding of concrete reinforcement is shown on the Contract Drawings, weld in accordance with AWS Dl.4.

D. Stainless steel bars shall be fabricated and bent using equipment that has been thoroughly cleaned or otherwise modified to prohibit contamination of the stainless steel from fragments of carbon steel or other contaminants. Do not use carbon steel tools, chains, slings, etc. when fabricating or handling stainless steel bars. Only use nylon or polypropylene slings. Bending shall be done in accordance with ASTM A955.

PART 3. EXECUTION

3.01 BENDING

The bar reinforcement shall be bent to the shapes shown on the Contract Drawings. Unless otherwise shown on contract documents, bending shall be in accordance with ACI 318. Reinforcing bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or improper bends will be rejected.

A. Epoxy-Coated Bar Reinforcement

The epoxy-coated bar reinforcement shall be shop bent before coating. If field bending is required, the epoxy coating must meet ASTM A775, and the bar shall be bent by cold methods only. Field bending of epoxy coating meeting ASTM A934 is not permitted. Any signs of damage to the epoxy coating in the field shall be repaired or will be rejected from the site. Damaged epoxy coating shall be repaired with patching materials conforming to ASTM A775 or ASTM A934 and performed in accordance with the manufacturer's written instructions. The maximum amount of repaired damaged coating shall not exceed 2% of the total surface area in each 1 ft of the bar. This limit does not include sheared or cut ends that are coated with patching material.

B. Galvanized Bar Reinforcement

The galvanized bar reinforcement shall be shop bent before galvanizing according to ASTM A767. If field bending is required, the bar shall be bent by cold methods only. All coating damage due to fabrication or handling shall be repaired with a zinc-rich formulation in accordance with ASTM A780. Any bar with damage not repaired will be rejected from the site. The maximum amount of repaired damaged coating shall not exceed 2% of the total surface area in each 1 ft of the bar. This limit does not include sheared or cut ends that are coated with patching material.

C. Stainless Steel Bar Reinforcement

The stailess steel bar reinforcement shall be shop bent or field bent as shown in the Contract Drawings and according to section 2.03 D. herin. If field bending is required, the bar shall be bent by cold methods only.

3.02 INSTALLATION

A. Place concrete reinforcement as shown on the Contract Drawings and on approved shop drawings. Where not shown on the Contract Drawings, comply with CRSI "Placing Reinforcing Bars".

B. Clean concrete reinforcement of loose rust, mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Stainless Steel Reinforcing Bars

As part of the Contractor's Quality Control, ensure stainless steel reinforcing bars show no signs of rusting, no surface imperfections, and maintain a uniform brightness.

1. Prior to shipping, ensure that all chains and steel bands will not come into direct contact with the stainless teel reinforcement bars. Place wood or other soft materials under the tie-downs. Alternatively, use nylon or polypropylene straps to secure the stainless steel reinforcement bars.

2. When bundles of reinforcement steel and stainless steel reinforcement bars must be shipped one on top of the other, the stainless steel reinforcement bars should be loaded on top. Use wooden spacers to separate the two materials.

3. Outside storage of stainless steel reinforcement bars is acceptable. Cover the stainless steel bars with tarpaulins. Store the bars off the ground or shop floor on wooden supports.

4. Clean, descale, and passivate all stainless steel reinforcing bars according to ASTM A 380 at the fabrication plant and the field as directed by the Engineer.

5. Stainless steel reinforcing bars will not be used on the site if there is one of the following:

   a. Any area of contamination of the stainless steel by iron exeeds 4 inches (100 mm) in length;

   b. Two or more areas of iron contamination greater than 1 inch (25 mm) in length occur along the length of the reinforcing bar;

   c. There are frequent small occurrences of rust contamination along the full length of the bar

   d. Mechanical damage to the bar during bending or straightening operations

D. Accurately position, support and secure concrete reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support concrete reinforcement by chairs, runners, bolsters, spacers, and hangers in accordance with CRSI Manual of Standard Practice". Do not interfere with placement of embedded items.

E. Splices will be permitted only where shown in the contract documents. Should the Contractor desire to splice bars at locations other than those shown in the Contract Documents, written permission to do so shall first be obtained from the

Engineer of Record.

F. When a vapor barrier is shown on the Contract Drawings, do not cut or puncture during concrete reinforcement placement.

G. Place concrete reinforcement to obtain covers shown on the Contract Drawings for concrete protection, or in accordance with ACI 318 "Concrete Protection for Reinforcement", if not shown on the Contract Drawings. Arrange, space, and securely tie bars and bar supports to hold concrete reinforcement in position during concrete placement operations. Set ties so ends are directed into concrete, not toward exposed concrete surfaces.

H. Concrete shall not be placed until the reinforcing steel is inspected, placement of the steel meets applicable tolerances, and permission for placing concrete is grants. All concrete placed in violation of this provision will be rejected and shall be removed.

F. Install welded wire fabric in lengths as long as practical. Lap adjoining pieces at least one full mesh and lace splices with wire, but in no case shall lap be less than requirements of ACI 318 "Splices of Welded Deformed Wire Fabric in Tension" or "Splices of Welded Plain Wire Fabric in Tension". Offset end laps in adjacent widths to prevent continuous laps in either direction.

G. After concrete placement, do not field bend partially embedded concrete reinforcement except as shown on the Contract Drawings.

H. Repair damaged bars and welds, if any, in accordance with 2.O1A.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT
SUBMITTALS
APPENDIX "A"

The following items shall be submitted to the Engineer, except as otherwise noted.

A. Shop Drawings

1 As per Division 1, "Shop Drawings, Catalog Cuts and Samples".

2 Details indicating placement, cover, splice locations, lap lengths, mechanical splice hardware, grade, bar size, length, mark number, bending schedule, bending diagram, weld designations, type of coating, material used to repair coating, and types of chairs, spacers, hangers and tie wire for all concrete reinforcement.

3 All proposed changes to the size, spacing or arrangement of the reinforcing steel shown on the Contract Drawings shall be clearly flagged as such on the shop drawings.

B. Catalog Cuts, Material Certification and Test Results

1 As per Division 1, "Shop Drawings, Catalog Cuts and Samples".

2 Catalog cuts for chairs, spacers, hangers and mechanical splices.

3 Certification from the applicator of epoxy that the epoxy-coated reinforcing bars meet the requirements of ASTM A 775 (AASHTO M284).

4 Test results and certification from the galvanizer that the weight, application and testing of zinc coating conforms with specifications and ASTM A 767.

5 Certified mill test reports for all concrete reinforcement.

C. Samples

1 As per Division 1, "Shop Drawings, Catalog Cuts and Samples".

2 Mechanical Splice Hardware.

3 Material used to repair coating.

D. Design Computations

1. Design computations for all proposed changes to the size, spacing or arrangement of the concrete reinforcement shown on the Contract Drawings.

E. Quality Control Plan for Stainless Steel Reinforcing Bars

1. Special delivery, storage, and handling procedures

2. Cleaning, descaling, and passivation procedures

END OF APPENDIX "A"

DIVISION 3

SECTION 03250

POST-TENSIONING

PART 1. GENERAL

1.01 SUMMARY

A. Furnish and install all post-tensioning systems and any other pertinent items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies and local zone reinforcement. Both temporary and permanent post-tensioning components shall comply with the requirements of this Section.

1. Install prestressing steel, which may be strands or bars, through ducts in the concrete. Stress to a predetermined load and anchor directly against the hardened concrete. Grout ducts to fill all voids and install protection at end anchorages.
2. Alternative Post-Tensioning Designs: Alternative designs using a post-tensioning scheme other than that shown on the Contract Drawings will not be permitted. Alternative refers to a 7-Wire Strand system secured by wedges seated in an anchorage plate.

B. Provide shop drawings signed and sealed by the Specialty Engineer for post-tensioning.

C. Related Work specified in other Sections of the Specifications includes the following:

1.	Concrete Reinforcement	Section 03200
2.	Portland Cement Concrete, Long Form	Section 03301
3.	Precast Segmental Concrete Bridges	Section 03432

D. SYSTEM DESCRIPTION

1. Furnish all components of a post-tensioning system, including steel pipes, from a single supplier. Obtain prestressing steel and local zone reinforcement from the same supplier.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

<u>American Association of State Highway and Transportation Officials (AASHTO)</u>

AASHTO LRFD	LRFD Bridge Design Specifications (6th Edition, 2012)

<u>American Concrete Institute (ACI)</u>

ACI 503R	Use Of Epoxy Compounds With Concrete

<u>American Society for Testing and Materials (ASTM International)</u>

ASTM	*Standard Specification for:*
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and

	Strip for Pressure Vessels and for General Applications
ASTM A416	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A722	Uncoated High-Strength Steel Bars for Prestressing Concrete
ASTM	*Standard Test Method for:*
ASTM C157	Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C939	Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C1202	Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM D3035	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D3895	Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4101	Polypropylene Injection and Extrusion Materials
ASTM D5989	Extruded and Monomer Cast Shapes Made from Nylon (PA)
ASTM F714	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM D395	Rubber Property Compression Set
ASTM D412	Vulcanized Rubber and Thermoplastic Elastomers Tension
ASTM D471	Rubber Property Effect of Liquids
ASTM D570	Water Absorption of Plastics
ASTM D573	Rubber Deterioration in an Air Oven
ASTM D638	Tensile Properties of Plastics
ASTM D895	Water Vapor Transmission of Shipping Containers Constant and Cycle Methods
ASTM D1000	Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
ASTM D1171	Rubber Deterioration Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D2137	Rubber Property Brittleness Point of Flexible Polymers and Coated Fabrics
ASTM D2240	Rubber Property Durometer Hardness
ASTM E28	Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus
ASTM E96	Water Vapor Transmission of Materials
ASTM E274	Skid Resistance of Paved Surfaces Using a Full-Scale Tire
ASTM F2136	Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

Deutsches Institut für Normung e.V. (German Institute for Standardization)

DIN 30 672M

Federal Specification

MIL-P-3420 Performance Specification: Wrapping Materials, Volatile Corrosion Inhibitor Treated, Opaque

International Federation of Structural Concrete (FIB)

FIB Technical Report, Bulletin 7 "Corrugated Plastic Duct for Internal Bonded Post-Tensioning"

Post-Tensioning Institute (PTI)

PTI M55-1.12 Specification for Grouting of Post-Tensioned Structures

1.03 DEFINITIONS

A. Anchorage Assembly: An assembly of various hardware components which secures a tendon at its ends after it has been stressed and, imparts the tendon force into the concrete.

B. Anticipated Set: The wedge set assumed to occur in the design calculation of the post-tensioning forces at the time of load transfer.

C. Bar: Post-tensioning bars are high strength steel bars, normally available from 5/8 to 2-1/2 inch diameter and usually threaded with very coarse thread.

D. Bearing Plate: Any hardware that transfers the tendon force directly into a structure.

E. Bleed: The autogenous flow of mixing water within or its emergence from, newly placed grout, caused by the settlement of the solid materials within the mass.

F. Coupler: A device used to transfer the prestressing force from one partial length prestressing tendon to another.

1. Strand couplers are not permitted.

G. Duct: Material forming a conduit to accommodate prestressing steel installation and provide an annular space for the grout which protects the prestressing steel.

H. Engineer: As defined in Division 1.

I. Family of Systems: Group of post-tensioning tendon assemblies of various sizes which use common anchorage devices and design. All components within the family of systems shall be furnished by a single supplier and shall have a common design with varying sizes.

J. Fluidity: A measure of time, expressed in seconds necessary for a stated quantity of grout to pass through the orifice of a flow cone.

K. Grout: A mixture of cementitious materials and water with or without mineral additives or admixtures, proportioned to produce a pumpable consistency without segregation of the constituents, when injected into the duct to fill the space around the prestressing steel.

L. Grout Cap: A device that contains the grout and forms a protective cover sealing the post-tensioning steel at the anchorage.

M. Inlet: Tubing or duct used for injection of the grout into the duct.

N. Local Zone Reinforcement: Reinforcement confining the volume of concrete immediately ahead of and surrounding the anchorage device as defined by the AASHTO

LRFD code.

O. Outlet: Tubing or duct to allow the escape of air, water, grout and bleed water from the duct.

P. Permanent Bar/Tendon: A bar or strand tendon that remains in the completed structure, regardless of its original use.

Q. Post-tensioning: A method of prestressing where tensioning of the tendons occurs after the concrete has reached a specified strength.

R. Prestressing Steel: The steel element of a post-tensioning tendon which is elongated and anchored to provide the necessary permanent prestressing force.

S. Post-Tensioning Scheme or Layout: The pattern, size and locations of post-tensioning tendons provided by the Designer on the Contract Drawings.

T. Post-tensioning System: An assembly of specific models of hardware, including but not limited to anchorage assembly, local zone reinforcement, wedge plate, wedges, inlet, outlet, couplers, duct, duct connections and grout cap, used to construct a tendon of a particular size and type. The entire assembly must meet the system pressure testing requirement. Internal and external systems are considered independent of one another.

U. Pressure Rating: The estimated maximum pressure that water in a duct or in a duct component can exert continuously with a high degree of certainty that failure of the duct or duct component will not occur (commonly referred to as working pressure).

V. Quality Control Data Sheet: A summary of the product being furnished that includes material parameters and the results of testing that show compliance with the requirements of these specifications.

W. Set (also Anchor Set or Wedge Set): Set is the total movement of a point on the strand just behind the anchoring wedges during load transfer from the jack to the permanent anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components. For bars, set is the total movement of a point on the bar just behind the anchor nut at transfer and is the sum of slippage of the bar and the elastic deformation of the anchorage components.

X. Specialty Engineer: A Professional Engineer registered in the States of New Jersey and New York, other than the Engineer of Record or his subcontracted consultant, who undertakes the design and drawing preparation of components, systems, or installation methods and equipment for specific temporary portions of the project work or for special items of the permanent works not fully detailed in the plans and required to be furnished by the Contractor.

1. The Specialty Engineer may also provide designs and details for items of the permanent work declared by the Authority to be "minor" or "non-structural".
2. The Specialty Engineer may be an employee or officer of the Contractor or a fabricator, an employee or officer of an entity providing components to a fabricator, or an independent consultant.

Y. Strand: An assembly of several high strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

Z. Temporary Bar/Tendon: A bar or strand tendon that does not remain in the completed structure, regardless of its original use.

AA. Tendon: A single or group of prestressing steel elements and their anchorage assemblies

imparting prestress forces to a structural member or the ground. Also, included are ducts, grouting attachments, grout and corrosion protection filler materials or coatings.

BB. Tendon Size: The number of individual strands of a certain strand diameter or the diameter of a bar.

CC. Tendon Type: The relative location of the tendon to the concrete shape, internal or external.

DD. Thixotropic: The property of a material that enables it to stiffen in a short time while at rest, but to acquire a lower viscosity when mechanically agitated.

EE. Wedge Plate: The hardware that holds the wedges of a multi-strand tendon and transfers the tendon force to the anchorage assembly. (commonly referred to as anchor head)

FF. Wedge: A conically shaped device that anchors the strand in the wedge plate.

1.04 QUALITY ASSURANCE

A. Installer Qualifications

1. Qualifications: Perform all post-tensioning field operations under the direct supervision (crew foreman) of a qualified post-tensioning and grouting technician.
   a. The crew foreman for post-tensioning tendons installation and stressing shall have PTI Certification, Level 2 Bonded PT – Field Installation/Field Specialist.
   b. The crew foreman for grouting operations shall be an ASBI Certified Grouting Technician with a continuous minimum verifiable experience of five years.
2. Conduct all stressing and grouting operations in the presence of the Engineer.

B. Contractor's Engineer Qualifications

1. A Specialty Engineer is qualified if he or she has the following qualifications:
   a. Registration as a Professional Engineer in the States of New Jersey and New York;
   b. The education and experience necessary to perform the submitted design as required by the Professional Engineering Boards of the States of New Jersey and New York.

C. Mock-ups

1. Protection of Post-Tensioning Anchorages (Elastomeric Coating): Construct a 2 x 4 ft concrete test block with a similar surface texture to the surfaces to be coated and coat a vertical face with the elastomeric coating system chosen.
   a. Determine the number of coats required to achieve a coating thickness between 30 to 45 mils without runs and drips.
   b. Mix and apply elastomeric coating as per manufacturer's current standard technical specifications. Spray or roller application is permitted, spray application is preferred.
   c. Have the coating manufacturer representative on site to supervise and comment on the application of the elastomeric coating onto the test block.
   d. Apply coatings using approved and experienced personnel with a minimum of three years experience applying similar polyurethane systems.
   e. Submit the credentials of these persons to the Engineer for review and consideration for approval.

D. Pre-Installation Conference

1. Schedule a pre-installation conference a minimum of two weeks prior to the start of post-tensioning installation and stressing. Topics for presentation and discussion include means and methods for:

   a. Installing strand,

   b. Stressing strand including measuring of elongations,

   c. Grouting tendon ducts

1.05 DELIVERY, STORAGE, PROTECTION AND HANDLING

A. Prestressing Steel: Protect all prestressing steel against physical damage and corrosion at all times, from manufacturer to final grouting or encasing in the concrete. The Engineer will reject prestressing steel that has sustained physical damage.

1. Carefully inspect any reel that is found to contain broken wires during use and remove and discard lengths of strand containing broken wires. The wire must be bright and uniformly colored, having no foreign matter or pitting on its surface.

2. Packaging: Prestressing steel must be packaged in containers for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor, which prevents rust, must be placed in the package, or be incorporated in a corrosion inhibitor carrier type packaging material. The corrosion inhibitor must have no deleterious effect on the steel or the concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material must conform to the provisions of Federal Specification MIL-P-3420. Immediately replace or restore packaging damaged from any cause, to the original condition.

3. The shipping package must be clearly marked with a statement that the package contains high-strength prestressing steel, the care to be used in handling, and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use. Specifically designate low relaxation (stabilized) strands per requirements of ASTM A416. Strands not so designated will be rejected.

B. Shipping/Storage of Ducts: Furnish duct with end caps to seal the duct interior from contamination. Ship in bundles which are capped and covered during shipping and storage. Protect ducts against ultraviolet degradation, crushing, excessive bending, dirt contamination and corrosive elements during transportation, storage and handling. Do not remove end caps supplied with the duct until the duct is incorporated into the bridge component. Store duct in a location that is dry and protected from the sun. Storage must be on a raised platform and completely covered to prevent contamination. If necessary, wash duct before use to remove any contamination.

C. Tendon Protection: Within 4 hours after stressing, install grout caps and seal all other tendon openings. If acceptance of the tendon is delayed, seal all tendon openings and temporally weatherproof the open ends of the anchorage. If tendon contamination occurs, remove and replace the tendon.

D. During Installation in the Structure

1. For bars located in superstructures and all strands (superstructure and substructure), the time between the first installation of the prestressing in the duct and the completion of the stressing and grouting operations shall not exceed 10 calendar days.

2. For bars located in substructures, the time between the first installation of the bar in the duct and the completion of the stressing and grouting operations shall not exceed 21 calendar days.

3. Any light surface corrosion forming during this period of time will not be cause for rejection of the prestressing steel.

E. Storage of Post-Tensioning Grout: Store grout in a location that is both dry and convenient to the work. Storage in the open must be on a raised platform and with adequate waterproof covering to protect the material. On site storage of grout is limited to a maximum period of one month.

F. Elastomeric Coating System - Packaging and Labeling: Ship materials in containers legibly marked with application instructions, lot number, batch number, date of manufacture, and shelf life.

G. Magnesium Ammonium Phosphate Concrete - Material Supply, Storage, and Marking:

1. The material shall be pre-proportioned including aggregate. Deliver products in original, unopened containers with manufacturer's name, date of manufacture, and clearly marked with all information described below.

2. Store the material in an elevated dry and weather protected enclosure in full compliance with the manufacturer's recommendations. Material must be used within manufacturer's recommended shelf life.

3. The material from which the containers are made shall have water vapor transmission not greater than 100 g/m^2 in 24 hours as determined in accordance with Procedure B of ASTM E96.

4. All containers shall be marked with the following information:

   a. LOT identification number and material expiration date

   b. Directions for use shall include but are not limited to the following:

      (1) The type and kind of adhesive recommended (if any) to bond fresh repair material to the concrete or mortar being repaired.

      (2) The recommended amount of resin, other liquid component, or both, to be mixed with the package contents.

      (3) The recommended length of mixing time or sequence of mixing and resting times in minutes.

   c. Date the material was packaged.

   d. The yield in cubic feet or yield in ft^2/in thickness when mixed with the recommended amount of liquid.

   e. The net weight in each container. The contents of any container shall not vary by more than 2% from the weight stated in the declarations. The average weight of filled containers in a LOT shall be not less than the individual weight stated in the declarations.

   f. Instructions for the maximum and minimum water (or solutions) to cementitious material ratio.

   g. State the approximate working time.

5. Rejection: All broken containers will be rejected. Material that fails to meet any of the requirements of this Specification will be rejected. Report all materials failing to meet this specification and state the reason(s) for rejection in writing to the Engineer and the producer or supplier.

a. Material in local storage in the hands of a vendor for more than six months after testing will be retested before use, except for the scaling resistance test and length change immersed in sulfate solution test for Magnesium Ammonium Phosphate Concrete.

b. Retested material will be rejected if it fails to conform to any of the requirements of this Specification.

1.06 TESTING

A. Post-Tensioning Materials

1. Samples for Testing and Identification:

a. General: Testing must conform to the applicable ASTM Specifications for the prestressing material used. Furnish all material samples for testing at no cost to the Authority. Consider the job site or site referred to herein, as the location where the prestressing steel is to be installed, whether at the bridge site or at the casting yard.

b. Prestressing Steel: Furnish samples for testing as described below for each manufacturer of prestressing strand and bar to be used on the Project.

(1) With each sample of prestressing steel strand or bar furnished for testing, submit a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

(2) The Engineer will sample the following materials, at the plant or jobsite, from the prestressing steel used for post-tensioning operations:

(a.) For strand: three randomly selected samples, 5 feet long, per manufacturer, per size of strand, per shipment, with a minimum of one sample for every ten reels delivered.

(b.) For bars: three randomly selected samples, 5 feet long, per manufacturer, per size of bar, per heat of steel, with a minimum of one sample per shipment.

(3) One of each of the samples furnished to represent a LOT will be tested. The remaining samples, properly identified and tagged, will be stored by the Engineer for future testing. In the event of loss or failure of the component the stored sample will be utilized to evaluate for minimum strength requirements. For acceptance of the LOT represented, test results must show 100% of the guaranteed ultimate tensile strength.

2. LOTs and Identification: A LOT is that parcel of components as described herein. All bars, of each size from each mill heat of steel, and all strand from each manufactured reel to be shipped to the site must be assigned an individual LOT number and must be tagged in such a manner that each LOT can be accurately identified at the job site.

a. Submit records to the Engineer identifying assigned LOT numbers with the heat, or reel of material represented. All unidentified prestressing steel, or bars received at the site will be rejected. Also, loss of positive identification of these items at any time will be cause for rejection.

b. Provide a copy of the grout Quality Control Data Sheet (QCDS) to the Engineer, from the manufacturer for each LOT number and shipment sent to the job site. Materials with a total time from manufacturer, in excess of six months, must be retested and certified by the supplier before use or be removed from the project and replaced.

B. Magnesium Ammonium Phosphate Concrete - Sampling, Mixing, and Additional Testing: A LOT is the packaged repair material normally placed on a pallet. A unit sample is a single container or package of material randomly selected from the LOT.

1. Mix and install the material(s) in accordance with the manufacturer's recommendations. Manufacturers will be required to provide field representation upon request by the Engineer.
2. The Authority reserves the right to conduct further field testing on any approved material.
3. Laboratory Specimen Preparation
   a. Mixing and Fabrication: Mechanically mix the dry packaged materials with liquid components in accordance with the manufacturer's recommendations.
   b. Length Change: Make and cure the test specimens in accordance with ASTM C157, except omit the curing period in Section 10.3; however both 11.1.1 and 11.1.2 shall apply for 28 day curing period.
   c. Manifestly Faulty Specimens: Visually examine each group of specimens representing a given test or a given age of test, including tests of freshly mixed concrete, before or during the test, or both, whichever is appropriate. Discard any specimen found to be manifestly faulty by such examination without testing.
      (1) Visually examine all specimens representing a given test at a given age after testing, and should any specimen be found to be manifestly faulty the test results thereof shall be disregarded. Should more than one specimen representing a given test at a given age be found manifestly faulty either before or after testing, the entire test shall be disregarded and repeated.
      (2) The test result reported shall be the average of the individual test results of the specimens tested or, in the event that one specimen or one result has been discarded, it shall be the average of the test results of the remaining specimens.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Post-tensioning Systems

1. Manufacturers seeking evaluation of their post-tensioning systems must submit test results to the Authority's Materials Engineering Unit (MEU) and include certified test reports from an independent laboratory audited by AASHTO Materials Reference Laboratory (AMRL) which shows the post-tensioning system meets all the requirements specified herein.
2. Manufacturers must also submit fully detailed drawings showing all components of their post-tensioning systems.

a. Test plastic components in a certified independent laboratory accredited through the laboratory accreditation program of the Geosynthetic Accreditation Institute (GAI) or the American Association for Laboratory Accreditation (AALA). Certification of test reports may be performed by an independent laboratory located outside the U.S. if the independent laboratory is approved by the Authority's Materials Division.

3. Test and include typical local zone reinforcement in the system drawings that are submitted for system approval. Final design and details of local zone reinforcement are project specific and are the responsibility of the post-tensioning system supplier. The typical local zone reinforcement shown on the approved system drawings or project specific reinforcement may be used.

   a. Design project specific local zone reinforcement for the same number of strands used for the design of the approved system. Do not design project specific local zone reinforcement for a reduced system capacity. Submit signed and sealed details of the local zone reinforcement to the Engineer for review and approval.

4. If any component of the post-tensioning system is modified or replaced, excluding local zone reinforcement, the appropriate component test and entire system test, if applicable, must be repeated in accordance with the requirements herein and an updated submission made to the Authority's Materials Engineering Unit. The submission shall include test reports and revised system drawings.

   a. Before attempting to change post-tensioning system components contact the Authority for direction.

5. Ensure that all components of a system are stamped with the suppliers name, trademark model number and size corresponding to catalog designation. Post-tensioning systems consist of an assembly of components for various sizes of strand or bars assembled and pressure tested.

6. Develop and test post-tensioning systems for both internal (corrugated duct) and external (smooth duct) applications for each of the following:

   a. Tendon sizes proposed for the Project which consist of multiple 0.6 inch diameter strand in anchorages.

   b. Bar sizes proposed for use on the Project.

   c. Systems using alternative anchorage sizes and/or strands utilizing 1/2 inch strand and providing equivalent force to these standard sizes may be submitted for approval.

7. Prior to installing any post-tensioning hardware, furnish the Engineer with a certification from the post-tensioning supplier that the post-tensioning system chosen for the project meets the requirements of this Section along with a list of the system components and drawings.

2.02 MATERIALS

A. Water: Section 03301

B. Post-tensioning Grout: This subsection covers grouts to be used to protect post-tensioning steel. Use Class C Grout as defined in Section 3.3 of the "Specification for Grouting of Post Tensioning Structures". Meet the material requirements of Section 2 of the "Specification for Grouting of Post Tensioning Structures".

   1. Certification:. Provide written certification as defined in Section 4.3 of the "Specification for Grouting of Post Tensioning Structures".

2. Prepackage grouts in moisture proof containers. Indicate the following on the bags:
   a. Application,
   b. Date of manufacture,
   c. LOT number, and
   d. Mixing instructions.
3. Any change of materials or material sources requires new testing and certification of the conformance of the grout with this Specification. Provide a copy of a Quality Control Data Sheet for each lot number and shipment sent to the job site to the Contractor by the grout supplier; furnish a copy to the Engineer.
   a. Test and certify (by the supplier) materials with a total time from manufacture to usage in excess of six months. Testing and certification to confirm that the product meets the QC Control Specifications before use of the material. Remove and replace untested and uncertified materials.
4. Mixing: Mix the material in accordance with the manufacturer's recommendations.
5. Grout Physical Properties.
   a. Gas Generation: Aluminum or other components which produce hydrogen, carbon dioxide or oxygen gas are prohibited.
   b. Perform testing requirements for Class C grout per Section 3.4 of the "Specification for Grouting of Post Tensioning Structures".
   c. Laboratory Test: Meet testing requirements from Section 4.4 of the "Specification for Grouting of Post Tensioning Structures".
6. Accelerated Corrosion Test Method (ACTM): Perform the ACTM as outlined in Appendix B of the "Specification for Grouting of Post Tensioning Structures" published by the Post-Tensioning Institute. Report the time to corrosion for both the grout being tested and the control sample using a 0.45 water-cement ratio neat grout.
   a. A grout that shows a longer average time to corrosion in the ACTM than the control sample and the time to corrosion exceed 1,000 hours is considered satisfactory.
7. Variation in Testing for Specific Applications.
   a. Horizontal Applications: Horizontal grout applications are defined as grouting of all superstructure tendons and transverse substructure tendons in caps, struts, etc. All physical requirements defined in Subsections 2.02.B.05 and 2.02.B.06 are applicable for grouts used in horizontal applications.
   b. Vertical Applications: Vertical grout applications are defined as grouting of substructure column tendons and vertical post-tensioning bars in the superstructure. All physical requirements defined in Subsections 2.02.B.05 and 2.02.B.06 are applicable for grouts used in vertical applications.
      (1) In addition, perform the Schupack Pressure Bleed Test Procedure for Cement Grouts for Post-Tensioned Structures as outlined in Appendix C of the "Specification for Grouting of Post-Tensioned Structures" published by the Post-Tensioning Institute.
      (2) Report the percent bleed for the grout tested. Test grout at the specified pressure of 100 psi. An acceptable test will result in no bleed water (0.0 percent).

c. Repair Applications: Repair applications are used to augment grouting operations which did not completely fill the duct or anchorage. For new construction, repairs maybe made with the same grout approved for use in the tendon as long as the volume of the void is less 0.5 gal.

(1) In all other cases, use a non-sanded grout meeting the requirements of Subsections 2.02.B.05 and 2.02.B.06 with a modified maximum permeability of 2,800 coulombs (ASTM C1202 at 30 volts). Non-sanded grouts shall have 95% passing on the #100 sieve and 90% passing the #170 sieve as determined by ASTM C33. Each sieve may be washed and dried before weighing in accordance with the procedure in ASTM C117 modified for sieve size.

C. Epoxy Resin Compounds

1. General: Epoxy resin compounds for application to Portland cement concrete, metals and other type surfaces shall be a two-component system. The compound shall contain no volatile solvent and shall be basically pure reactive material with a maximum ash content of 2%.

2. Mix Ratio: Provide compounds with a simple mix ratio of:

a. One to one, or

b. Two to one, or

c. Packaged in pre-measured containers in which all of the contents of both packages are to be mixed.

3. Terms:

a. Low modulus: Stress-strain property for which ultimate tensile strength is attained at over 10% elongation.

b. High modulus: Stress-strain property for which ultimate tensile strength is attained at under 6% elongation.

c. Non-sagging gel: Grades of mixed compounds which will not perceptibly flow under their own weight on a vertical surface in the unhardened state.

d. Pourable: Grades of mixed compound sufficiently fluid that they (either neat or filled) can be cast into and will take the shape of a mold.

4. Certification: The Contractor shall provide the Engineer with certification from the manufacturer of the epoxy, confirming that the requirements of this Section are met. The certification shall conform to the requirements of Section 6. Each certification shall cover only one batch of epoxy materials.

5. Specific Requirements: These epoxy materials are to be used to protect the anchorages of post-tensioning tendons or bars and other uses indicated in the Contract Drawings. The material shall produce a low exothermic reaction and have flow and fill characteristics suitable for machine base plate applications. The material will be extended with the aggregate supplied by the manufacturer. Mix with the full aggregate loading unless the use of less aggregate is approved by the Engineer.

a. The material shall be factory pre-proportioned including factory supplied aggregate.

b. Deliver products in original containers with manufacturer's name, date of manufacture, product identification label and batch numbers.

c. Materials must be within the manufacturer's recommended shelf life.

d. Store and condition the product in full compliance with manufacturer's recommendations.

e. The epoxy grout plus aggregate mix shall meet or exceed the specified physical properties stated herein as determined by the following standard ASTM test methods.

Property	Test Value	Test Method
Compressive Strength Cubes 7 day Cure at 77 deg. F	> 10,000 psi	ASTM C579B
Tensile Strength at 7 days	> 2,100 psi	ASTM C307
Flexural Strength at 7 day Cure at 77 deg. F	> 3,600 psi	ASTM C580
Modulus of Elasticity 7 day Cure at 77 deg. F	< 2,100,000 psi	ASTM C580
Coefficient of Thermal Expansion at 74 to 210 deg. F	< 20 x 10^{-6} in/in/°F	ASTM C531
Peak Exotherm Specimen 12 x 12 x 3 in.	< 150° F	ASTM D2471
Slant Shear at 7 days (Bond Strength to Concrete)	> 3000 psi	ASTM C882
Thermal Compatibility	5 Cycles Passed	ASTM C884

6. Fillers: Fillers for mixing mortars and grouts may be as recommended by the manufacturer of the particular epoxy compound and may be supplied as packages accompanying the epoxy or premixed in accordance with approved properties.

a. If a manufacturer recommends only the gradation of filler, it must be silica sand commercially available and shall be a gradation listed in Table I or a specified blend of these gradations.

b. The silica sands specified in Table 1 shall be clean, kiln dried, packaged in strong moisture proof bags, contain no more than 0.2% organic trash, and be chloride free.

c. When the fillers specified in Table 1 are used, the maximum amount shall be 2.25 volumes to one volume of mixed compound.

TABLE 1
Gradation Requirements For Fillers For Use With Epoxy Compounds

	A	B	C*	D
Sieve Opening Size	Required % Passing			
No.4			95-100	95-100
No.6		90 - 100		
No.8			0 - 15	85 - 100
No. 16				65 - 97
No. 20	80 - 100	0 - 20		
No. 30	0 – 40			25 - 70
No. 50	0 - 10			5 - 35
No. 100				0 - 7

* For use only in sections 1 ½ inches or greater in thickness

D.

E. Magnesium Ammonium Phosphate Concrete

1. General: This material is intended to be used to repair block-outs and voids in post-tensioned elements, load bearing area of a beam, and other locations required by the Contract Documents. This material may be used for the repair of horizontal or vertical surfaces.

   a. Follow the manufacturer's recommendations for preparing the surfaces and for mixing, placing and curing the concrete.

   b. This material shall be a magnesium ammonium phosphate based concrete (MAPC).

2. Physical Properties: The MAPC material shall meet or exceed physical properties stated in Table 2 as determined by the specified standard test methods.

TABLE 2
Physical Properties of Repair Material in High Stress Area

Requirement	Test Method	Test Value
Minimum Compressive Strength (at 28 days), psi	ASTMC-109*	8,500
Minimum Flexural Strength (at 28 days), psi	ASTM C348*	600
Minimum Slant Shear Bond (at 14 days), psi	FM 5-587*	2,500
Time of Setting (Initial), minutes	ASTM C-191 **	15 to 60
Maximum Scaling Resistance	ASTMC 672	No scaling
Maximum Length Change, %		
Allowable expansion at 28 days when water cured compared to length at one day	ASTM C-157***	0.03
Allowable shrinkage at 28 days when air cured compared to length at one day		-0.03
Maximum Allowable Total Chlorides, lbs/yd^3	FM 5-516	0.40

* The test methods for compressive strength (ASTM C-109), flexural strength (ASTM C-348), and Slant Shear Bond (FM 5-587) shall be modified so that the specimens are air cured instead of moist cured. All of these samples shall be air cured until the time of testing..

** Initial time of set for MAPC will be tested in accordance with ASTM C-191 with the following modification. The initial time of set shall be tested at 95 deg F plus or minus 5 deg F.

*** Make and cure the test specimens in accordance with ASTM C-157, except omit the curing period in Section 10.3; however both 11.1.1 and 11.1.2 shall apply for 28 day curing period.

3. Specimen Requirements

   a. Curing of Compressive Strength, Flexural Strength and Slant Shear Bond Specimens: The test methods for compressive strength (ASTM C-109), flexural strength (ASTM C-348), and Slant Shear Bond (FM 5-587) shall be modified so that the specimens are air cured instead of moist cured. All of these samples shall be air cured until the time of testing.

   b. Time of Setting: Initial time of set for MAPC will be tested in accordance with ASTM C-191 with the following modification. The initial time of set shall be tested at 95° plus or minus 5° F.

F. Elastomeric Coating System

1. General Requirements: Use an elastomeric coating system to provide a waterproof barrier over post-tensioning anchorages or other areas designated in the Contract Drawings.

a. Supply the components of the coating system from a single manufacturer and sold as a waterproof coating system. Perform the surface preparation and application of the coating system in strict accordance with the manufacturer's specifications and instructions.

b. Upon curing, all coatings and/or coating systems must produce an adherent coating that is visually uniform. The composition of the coating is left to the discretion of the manufacturer but the finished product shall meet all requirements of this Section. All coats of multi-coat systems shall be supplied by the same manufacturer. Multi-component coatings shall be prepackaged in the required ratios.

c. Environmental Requirements: Coating materials and their waste shall be characterized as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subarticle C rules, Table 1 of 40 CFR 261.24 Toxicity Characteristic.

d. Volatile Organic Compounds (VOC) shall be less than 3.5 lb/gal when tested in accordance with ASTM D3960.

e. Material Approval: Submit the following for evaluation and approval.

(1) Product data sheets,

(2) Performance test reports from an independent laboratory showing the product meets the requirements of this section,

(3) Product MSDS or performance test reports showing percent weight compositional analysis including Chemical Abstract Number, ACGIH time weighted average and ceiling exposure limits for all components, lower and upper explosive limits, flash point, boiling point, amount of volatile organic compounds by weight, and specific gravity for each component of the coating system.

2. Physical Properties: The use of an epoxy prime coat is dependent upon the requirements of the manufacturer's waterproofmg system. The polyurethane chemistry may be either waterborne aromatic (moisture-curing) or aromatic (moisture-sensitive). The minimum thickness of the system shall not be less than 30 mils. Meet the following requirements for the elastomeric coating:

Property	Requirement	Test Method
Hardness, Shore A	Between 60 and 90	ASTM D2240
Tensile Strength	≥ 750 psi	ASTM D412
Elongation	≥ 400%	ASTM D412
Tear Strength	> 70 pli	ASTM C957
Abrasion Resistance H -18 wheels 1,000 gm/wheel	≤ 350 mg loss / 1,000 revs.	ASTM C957
Crack Bridging 1,000 Cycles	System Passes	ASTM C957
Elongation Recovery	≥ 94%	ASTM C957

3. System Modifications for Use on Bridge Substructure: Supply the elastomeric coating system with a 100% acrylic aliphatic polyurethane top coating.

G. High Molecular Weight Methacrylate (HMWM).

1. General: Perform the surface preparation and application of a high molecular weight methacrylate to seal cracks on horizontal and slightly sloped concrete surfaces as approved by the Engineer. Applications on bridge decks and other riding surfaces will require the addition of sand over the treated areas to increase the friction (skid) number measured as described by ASTM E274.

   a. The rate of application (gal/ft^2 of concrete) and the application method and equipment must be approved by the Authority prior to commencement of work based on the size, depth and the internal condition of cracks.

   b. Submit a written sealer application plan based on the above described crack characteristics for approval by the Authority. In addition, provide a minimum of 14 days advanced notice so that personnel from the Authority's Material Engineering Unit may be present at the beginning of work to evaluate the cracks and provide final approval of the application rate.

   c. Make arrangements with the material manufacturer to provide on-site technical assistance for the initial application and certify that the mixing ratio, application methods, and sand broadcasting are correct and in accordance with their recommendations.

   d. Maintain a daily log of used resin material to be verified by the Engineer. Include the drum or container identification number in the log as well as the date and location of use. Retain the containers at the jobsite until the Engineer verifies its use and authorizes removal from the site.

2. Materials:

   a. Methacrylate System: The system must be a three component system consisting of:

      (1) methacrylate monomer,

      (2) cumene hydroperoxide (CHP) initiator, and

      (3) cobalt promoter.

      (4) Use a HMWM monomer that is approved by the Authority.

      (5) Use initiator and promoter approved by the monomer manufacturer. Manufacturers seeking evaluation and approval of their products must submit the following documentation:

         (a.) Manufacturer's material installation instructions showing the product can be installed in accordance with this Section.

         (b.) Independent laboratory test data and results showing the product has been tested in accordance with the requirements of this Section and meets the requirements.

(6) Properties: Use a methacrylate material that meets the following physical and performance requirements:

Physical Properties of Methacrylate Resin	
Viscosity (Brookfield RVT)	14-20 cps at 50 rpm
Density (ASTM D1481)	8.5 -9.0 lb/gl at 77° F
Flash Point (ASTM D93)	> 200 of (Pensky Martens CC)
Odor	Low
Bulk Cure Speed	3 Hours @ 73° F (max.)
Surface Cure	8 Hours @ 73° F (max.)
Gel Time (ASTM 2471)	60 minutes (max.)
Tack Free Time	5 Hours (max.) at 72 of and 50% Relative Humidity
Compressive Strength (AASHTO TI06)	6,500 psi (min)
Tensile Strength (ASTM C307)	1,300 psi (min)
Shear Bond Adhesion (ASTM C882)	600 psi (min)
Wax Content	0

(7) Use a monomer with a shelf life of no less than 12 months. Use a monomer that is no more than 8 months old at the time of application. Provide each container shipped to the job site with the following information on a manufacturer's label:

(a.) Manufacturer's name,

(b.) Product name,

(c.) Lot or batch number;

(d.) *Date of production, and*

(e.) Drum serial number.

(f.) Identify the catalysts by their generic classification and provide the date of manufacture.

b. Sand: Use uniformly graded 6-20 (or similar), clean, bagged, blast sand for spreading over the applied polymer on bridge decks and other riding surfaces. Certify that the sand has a maximum moisture content that does not exceed 0.25% and that the maximum amount of dust or other material that may pass through a No. 200 sieve (-200 content) is not greater than 0.75%.

(1) Store the sand at a location that will preserve the above described conditions and characteristics of the sand until applied.

H. Prestressing Steel:

1. Strand: Unless otherwise noted on the Contract Drawings, use only bright, corrosion free, uncoated strand Grade 270, low relaxation 7-wire strand meeting the requirements of ASTM A416.

2. Bar: Unless otherwise noted on the Contract Drawings, use only bright, corrosion free, uncoated Grade 150, high strength, thread bar meeting the requirements of ASTM A722, Type II.

I. Post-Tensioning System: Use approved post-tensioning systems of the proper size and type to construct tendons shown on the Contract Documents. Substitution, modification or deletion of components of approved post-tensioning systems, excluding local zone reinforcement, is not permitted. For permanent applications, the use and location of bar couplers, other than those explicitly shown on the Contract Drawings, is subject to approval by the Engineer.

1. Use only post-tensioning systems that utilize tendons fully encapsulated in anchorages and ducts.

   a. Systems which transfer prestress force by bonding the prestress steel strand directly to concrete are not permitted.

   b. Embedded anchors for bars are permitted.

   c. Systems utilizing formed or ungrouted voids are not permitted for permanent post-tensioning. "Diabolos" may be used for future, external post-tensioning applications only.

   d. Strand or strand-tendon couplers are not permitted.

2. Post-Tensioning Anchorages: Ensure that the anchorages develop at least 95% of the actual ultimate tensile strength of the prestressing steel, when tested in an unbonded state, without exceeding the anticipated set.

   a. Design anchorages so that the average concrete bearing stress is in compliance with the AASHTO LRFD Bridge Design Specifications. Test anchorages with the typical local zone reinforcement shown in the system drawings. Provide written certification that anchorages meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.

   b. Galvanize the embedded body of the anchorage in accordance with ASTM A123. Other components of the anchorage including wedges, wedge plate and local zone reinforcement are not required to be galvanized. Construct the bearing surface and wedge plate from ferrous metal. Equip all anchorages with a permanent grout cap that is vented and bolted to the anchorage.

   c. Provide wedge plates with centering lugs or shoulders to facilitate alignment with the bearing plate.

   d. Cast anchorages with grout outlets suitable for inspection from either the top or front of the anchorage. The grout outlet will serve a dual function of grout outlet and post-grouting inspection access. The geometry of the grout outlets must facilitate being drilled using a 3/8 inch diameter straight bit to facilitate endoscope inspection directly behind the wedge plate. Anchorages may be fabricated to facilitate both inspection locations or may be two separate anchorages of the same type each providing singular inspection entry locations.

   e. Trumpets associated with anchorages will be made of either ferrous metal or polypropylene plastic material conforming to the requirements in Subsection 2.02.I.6. The thickness of the trumpet at the transition location will not be less than the thickness of the duct as established in Subsection 2.02.I.6. Alternately, the trumpet material may be polyolefin containing antioxidants with a minimum Oxidative Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes. Perform OIT tests on samples taken from the finished product. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours.

3. Bar Couplers and Nuts: Use couplers meeting the requirements of AASHTO LRFD Bridge Design Specifications and Bridge Construction Specifications. Test and provide written certification that the couplers meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.

4. Inlets, Outlets, Valves and Plugs: Provide permanent grout inlets, outlets, and threaded plugs made of ASTM A240 Type 316 stainless steel, nylon or polyolefin materials. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Products made from polyolefin shall contain antioxidants with a minimum OIT according to ASTM D3895 of not less than 20 minutes. Perform OIT tests on samples taken from the finished product. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours. All inlets and outlets will be equipped with pressure rated mechanical shut-off valves or plugs. Inlets, outlets, valves and plugs will be rated for a minimum pressure rating of 150 psi. Use inlets and outlets with a minimum inside diameter of 3/4 inch for strand and 3/8 inch for single bar tendons and four-strand duct.

   a. Provide dual mechanical shutoff valves when performing vertical grouting. Specifically designate temporary items, not part of the permanent structure, on the Post-tensioning System drawings. Temporary items may be made of any suitable material.

5. Permanent Grout Caps: Use permanent grout caps made from approved polymer or ASTM A240 Type 316L stainless steel. The approved resins used in the polymer shall be nylon, Acrylonitrile Butadiene Styrene (ABS) or polyester. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PAOI41 (weather resistant), S-PA0231 or S-PA040 1 (ultimate tensile strength not less than 10,000 psi with UV stabilizer added). Seal the cap with O-ring seals or precision fitted flat gaskets placed against the bearing plate. Use O-ring seals or precision fitted flat gaskets which meet the requirements of Subsection 2.02.I.10.b. Place a grout vent on the top of the cap. Grout caps must be rated for a minimum pressure rating of 150 psi and must meet the requirements of Subsection 3.03.A.6. Use ASTM A193, Grade B8M, Type 316 stainless steel bolts to attach the cap to the anchorage. When stainless steel grout caps are supplied, provide certified test reports documenting the chemical analysis of the steel.

J. Duct and Pipe

1. General: Use only plastic duct, steel pipe or a combination of plastic duct and steel pipe. Ensure that all connectors, connections and components of post-tensioning system hardware are air and water tight and pass the pressure test requirements herein. Use smooth plastic duct in all post-tensioning systems used for external tendons except where steel pipe is required. Use corrugated plastic duct in all post-tensioning systems used for all internal tendons except where steel pipe is required.

2. Duct or Pipe Minimum Diameter: For prestressing bars, provide duct with a minimum internal diameter of at least one-half inch larger than the outside diameter, measured across the deformations. For prestressing bars with couplers, size the duct to be one-half inch larger than the largest dimension of the largest enclosed element.

3. For multi-strand tendons, provide ducts with a minimum cross-sectional area two and one-half times the cross-sectional area of the prestressing steel.

4. Connection Tolerance between Pipe and Duct: Steel pipe and plastic duct may be connected directly to each other when the outside diameters do not vary more than plus or minus 0.08 inch. Use a reducer when the diameters of the steel pipe and the plastic duct are outside of this tolerance.

5. Steel Pipes: Use galvanized schedule 40 steel pipes where shown in the Contract Drawings and in all deviation blocks.

6. Corrugated Plastic Duct: Do not use ducts manufactured from recycled material. Use seamless fabrication methods to manufacture ducts.

   a. Use corrugated duct manufactured from non-colored, unfilled polypropylene meeting the requirements of ASTM D4101 with a cell classification range of PP0340B44541 to PP0340B67884. The duct shall be white in color containing antioxidants with a minimum OIT according to ASTM D895 of 20 minutes and containing a non-yellowing light stabilizer. Perform tests on samples from the finished product. Furnish duct with a minimum thickness as defined in the following table:

Duct Shape	Duct Diameter	Duct Thickness
Flat	any size	0.08 inch
Round	0.9 inch	0.08 inch
Round	2.375 inches	0.08 inch
Round	3.0 inches	0.10 inch
Round	3.35 inches	0.10 inch
Round	4.0 inches	0.12 inch
Round	4.5 inches	0.14 inch
Round	5.125 inches	0.16 inch
Round	5.71 inches	0.16 inch

   b. Testing Requirements for Corrugated Plastic Duct: Ensure that the duct system components and accessories meet the requirements of Chapter 4, Articles 4.1 through 4.1.8 of International Federation of Structural Concrete (FIB) Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-tensioning" as modified herein.

      (1) The requirements in FIB Technical Report, Bulletin 7, are modified as follows: Conduct the lateral load resistance test (FIB 4.1.4), without the use of a duct stiffener plate, using a load of 150 lbs. for all sizes; Wear resistance of duct (FIB 4.1.7) must not be less than 0.06 inch for duct up to 3.35 inches in diameter and not less than 0.08 inch for duct greater than 3.35 inches in diameter; Bond length test (FIB 4.1.8) must achieve 40% GUTS in a maximum length of 16 duct diameters.

c. Minimum Bending Radius for Corrugated Plastic Duct: In addition to the component testing stated herein, the manufacturer shall establish, through testing, the minimum bending radius for the duct. The test consists of a modified duct wear test as described in Chapter 4, Article 4.1.7 of FIB Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-Tensioning"'. The test apparatus shall be identical to the wear test apparatus with the same clamping force as a function of the number of strands in the duct; however, modify the procedure as follows: do not move the sample along the strand to simulate wear; the test duration will be 7 days. Upon completion of the test duration, remove the duct and the minimum wall thickness along the strand path must not be less than 0.06 inch for duct up to 3.35 inches diameter and not less than 0.08 inch for duct greater than 3.35 inches in diameter.

d. Corrugated Duct Connections and Fittings: Make all splices, joints, joints between segments (segmental construction), couplings and connections to anchorages with devices or methods (i.e. mechanical couplers, plastic sleeves in conjunction with shrink sleeve) producing a smooth interior alignment with no lips or kinks. Design all connections and fittings to be airtight. Duct tape is not permitted to join or repair duct connections.

e. Construct connections and fittings from polyolefin materials containing antioxidant stabilizers meeting the requirements of Subsection 2.02.H.4 or Subsection 2.02.I.6.

7. For post-tensioned systems intended for use with segmentally constructed superstructure or substructure, the post-tensioning system shall include duct couplers at the segment joints. The tendon duct coupler located at the segment joint shall be mounted perpendicular to the bulkhead and designed to receive a duct at an angle of 6 degrees deviation from perpendicular. The coupler must be able to accommodate angular deviation of the duct without the tendon strands touching the duct or coupler on either side of the segment joint.

8. Smooth Duct: Use smooth duct manufactured from 100% virgin polyethylene resin meeting the requirements of ASTM D3350 with a minimum cell class of 344464C. Use resin containing antioxidants. Perform tests on samples taken from the finished product. Minimum OIT (Oxidation Induction Time), according to ASTM D3895, shall be 40 minutes. Manufacture duct with a dimension ratio (DR) of 17.0 or less as established by either ASTM D3055 or ASTM F714 as appropriate for the manufacturing process used.

a. Use smooth duct meeting the minimum pressure rating (working pressure) of 100 psi and manufactured according to either ASTM D3035 or ASTM F714.

b. External Smooth Duct Connections: Use heat welding techniques to make splices between sections of plastic duct, in accordance with the duct manufacturer's instructions or make connections with electrofusion coupler or other mechanical couplers meeting the material requirements of this Specification. Ensure all connections have a minimum pressure rating (working pressure) of 100 psi, produce a smooth interior alignment and a connection with no lips or kinks.

c. Ensure all connections between steel pipe embedded in concrete and plastic duct are made by using a mechanical coupler or a circular sleeve made of Ethylene Propylene Diene Monomer (EPDM), having a minimum pressure rating (working pressure) of 100 psi. Use EPDM materials meeting the requirements of ASTM D1171 using Ozone Chamber Exposure Method B (ensure no cracks are exhibited under 2X magnification).

d. Use EPDM sleeves having a minimum wall thickness of 3/8 inch and be reinforced with a minimum of four ply polyester reinforcement. Use a 3/8 inch wide power seated band and clamps constructed from 316 stainless steel on each end of the boot to seal against leakage of grout. Install the band with an 80 to 120 lb seating force.

9. Corrugated Ferrous Metal Ducts: Do not use corrugated ferrous metal ducts in any location.

10. Internal Duct Mechanical Couplers, O-Rings, Segment Seal Assemblies and Heat Shrink Sleeve Requirements: Ducts for prestressing bars used exclusively for temporary post-tensioning are not required to be coupled across segment joints.

a. Mechanical Couplers: Construct mechanical internal duct couplers with stainless steel, plastic or a combination of these materials. Use plastic resins meeting the requirements of Subsection 2.02.H.4 or Subsection 2.02.I.6 to construct plastic couplers. Use ASTM A240 Type 316 stainless steel to make metallic components.

b. O-rings: Provide O-ring duct coupling assemblies and segment seal mounting assemblies made from plastic resins meeting the requirements of Subsection 2.02.H.4 or Subsection 2.02.I.6. Furnish standard O-ring material (diameter less than or equal to 0.25 inch), conforming to the following requirements:

Mechanical Properties	
Shore hardness, A ASTM D2240	50-75
Ultimate elongation %, ASTM D412	250% Min.
Tensile strength, ASTM D412	1400 psi Min.
Accelerated Testing	
Thermal Deterioration 70 hours @ 257 deg. F, ASTM D573	
Change in tensile strength	±30 %
Change of elongation	-50 %
Change of hardness	± 15 points
Compression Set Method B 22 hours @257 deg. F, ASTM D395	50 %
Volume change due to absorption of H_20, Method D, for 70 hours @ 212 deg. F, ASTM D471	+ 10 %
Environmental Resistance	
Ozone Resistance Exposure Method B, ASTM D1171	Pass
Low Temp. Non-brittle after 3 Min. @ -40 deg. F, ASTM D2137	Pass

(1) Furnish segment seal assemblies for large diameter compression seals, used to couple ducts at segment joints, conforming to the requirements stated above and with the following additions and changes:

Mechanical Properties	
Shore hardness, A ASTM D2240	30-60
Tensile strength, ASTM D412	600 psi Min.
Compression Set Method B 22 hours @257 deg. F, ASTM D395	60 %

(2)

(3) Compression Force:

(a.) The maximum force to compress the O-ring to its final compressed position shall not be greater than 25 psi times the area encircled by the O-ring.

(b.) Voided Area: The seal shall be designed to accommodate the material flow within its own cross-sectional area by using a hollow or voided design.

(c.) Mounting Assemblies: Assemblies holding the O-ring must mount to the form bulkhead and provide for duct alignment.

c. Heat Shrink Sleeves: Furnish heat shrink sleeves having unidirectional circumferential recovery manufactured specifically for the size of the duct being coupled consisting of an irradiated and cross linked high density polyethylene backing for external applications and linear-density polyethylene for internal applications. Furnish adhesive having the same bond value to steel and polyolefin plastic materials. Ensure the heat shrink sleeves have an adhesive layer that will withstand 125 deg. F operating temperature for internal applications and 150 deg. F operating temperature for external applications and meet the requirements of the following table:

Property	Test Method	Minimum Requirements	
		Internal Application	External Application
Minimum Fully Recovered Thickness		92 to 126 mils	111 mils
Peel Strength	ASTM D1000	29 pli	46 pli
Softening Point	ASTM E28	162°F	216°F
Lap Shear	DIN 30 672M	87 psi	58 psi
Tensile Strength	ASTM D638	2,900 to 3,480 psi	3,480 psi
Hardness	ASTM D2240	46 to 48 Shore D	52 Shore D
Water Absorption	ASTM D570	Less than 0.05%	Less than 0.05%
Color	N/A	Yellow or Black	Black
Minimum Recovery	Heat Recovery Test	33% to 58%	23%

(1) Install heat shrink sleeves using procedures and methods in accordance with the manufacturer's recommendations.

K. Grout: Use only grouts that conform to the requirements of this Section. Select the post-tensioning grout for use by the proper application either repair, horizontal or vertical. Mix grout with potable water meeting the requirements of Section 03301. Maintain grout fluidity in strict compliance with the grout manufacturer's recommendations and test with a flow cone.

L. Approval of Materials: The approval of any material by the Engineer will not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

PART 3. EXECUTION

3.01 PREPARATION

A. Grouting: Before grouting operations begin, a joint meeting of the Contractor, grouting crew and the Engineer will be conducted. At the meeting, discuss the grouting operation plan, required testing, corrective procedures and any other relevant issues.

B. Crack Sealing:

1. Surface Preparation:

a. Cleaning: On the day of application, thoroughly power sweep the area to be treated to remove all dust, dirt or debris present. On bridge decks, use a tractor mounted (or similar) power broom with non-metallic bristles suitable for the intended purpose.

Re-clean the deck as necessary just prior to the application as debris may be blown back onto the work area by adjacent traffic or other means. If present, remove oils and oil based substances from the concrete surface using an approved solvent.

b. Containment: Provide adequate containment to prevent the sealer material from flowing beyond the designated area of application. Plug any drain holes or openings within the work area. Prevent airborne material from dispersing onto open traffic lanes or outside the work area.

c. Perform mechanical grooving of the deck after cracks have been sealed.

3.02 INSTALLATION / APPLICATION

A. Duct Installation: Accurately and securely fasten all post-tensioning anchorages, ducts, inlet and outlet pipes, miscellaneous hardware, reinforcing bars, and other embedments at the locations shown on the Contract Drawings or on the approved Shop or Working Drawings or as otherwise approved by the Engineer. Construct tendons using the minimum number of duct splices possible.

1. Ducts: Accurately align ducts and position at the locations shown on the Contract Drawings or according to the approved Shop or Working Drawings or as otherwise approved by the Engineer. Securely fasten all internal ducts in position at regular intervals not exceeding 30 inches for steel pipes, 24 inches for round plastic duct and 12 inches for flat ducts to prevent movement, displacement or damage from concrete placement and consolidation operations. Show the method and spacing of duct supports on appropriate Shop Drawings. Ensure that ducts for external tendons are straight between connections to internal ducts at anchorages, diaphragms and deviation saddles and are supported at intermediate locations according to the Contract Drawings or approved shop drawings.

a. Ensure that all alignments, including curves and straight portions, are smooth and continuous with no lips, kinks or dents. This also applies to curves in pre-bent steel pipe.

b. Carefully check and repair all ducts as necessary before placing any concrete.

c. After installing the ducts and until grouting is complete, ensure that all ends of ducts, connections to anchorages, splices, inlets and outlets are sealed at all times. Provide an absolute seal of anchorage and duct termination locations by using plumber's plugs or equal. Grout inlets and outlets shall be installed with plugs or valves in the closed position. Leave low point outlets open. The use of duct tape is not permitted.

2. Splices and Joints: All splices, joints, couplings, connections (inlet and outlet) and valves shall be part of the approved post-tensioning system. Approved shrink-sleeve material may be used to repair duct. The use of any tape to repair or seal duct is not permitted. Special wrap designed for duct repair may be used with approval of the Engineer.

3. Location of Grout Inlets and Outlets: Place grout inlets and outlets at locations as shown on the Contract Drawings and shop drawings. Equip all grout inlets and outlets with positive shut-off devices. At a minimum, grout inlets and outlets shall be placed in the following positions:

   a. Top of the tendon anchorage;

   b. Top of the grout cap;

   c. At the high points of the duct when the vertical distance between the highest and lowest point is more than 20 inches;

   d. At a location 3 feet past high points of the duct on the down stream side opposite the direction of grouting; .

   e. At all low points;

   f. At major changes in the cross section of the duct;

   g. At other locations required by the Engineer: Extend grout tubes a sufficient distance out of the concrete member to allow for proper closing of the valves.

4. Tolerances: Ensure that post-tensioning ducts in their final position are within the following tolerances:

Tolerances	Vertical position (inches)	Lateral position (inches)
Horizontal tendons in slabs or in slab regions of larger members:	±1/4	± 1/2
Longitudinal draped super-structure tendons in webs: Tendon over supports or in middle third of span	±1/4	±1/4
Tendon in middle half of web depth	±1/2	±1/4
Longitudinal, generally horizontal, superstructure tendons usually in top or bottom of member:	±1/4	±1/4
Horizontal tendons in substructures and foundations:	±1/2	±1/2
Vertical tendons in webs	Longitudinal position ±1	Transverse position ±1/4
Vertical tendons in pier shafts	±1/2	±1/4

   (1) In all other cases, ensure that tendons are not out of position by more than plus or minus 1/4 inch in any direction.

   (2) Ensure entrance and exit angles of tendon paths at anchorages and at faces of concrete are within plus or minus 3 degrees of desired angle measured in any direction and any deviations in the alignment are accomplished with smooth transitions without any kinks.

   (3) Angle changes at duct joints must not be greater than plus or minus 3 degrees in any direction and must be accomplished with smooth transitions without any kinks.

(4) Locate anchorages within plus or minus 1/4 inch of desired position laterally and plus or minus 1 inch along the tendon except that minimum cover requirements must be maintained.

(5) Position anchorage confinement reinforcement in the form of spirals, multiple U shaped bars or links, to be properly centered around the duct and to start within 1/2 inch of the back of the main anchor plate.

(6) If conflicts exist between the reinforcement and post-tensioning duct, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally with the Engineer's approval.

B. Placing Concrete

1. Precautions: Use methods to place and consolidate concrete which will not displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments. Fabricate all duct splices to prevent duct kinks during concrete placement. Use mandrels as needed to maintain duct alignment and shape.

2. Proving of Post-Tensioning Ducts: Except as described below, upon completion of concrete placement, prove that the post-tensioning ducts are free and clear of any obstructions or damage and are able to accept the intended post-tensioning tendons by passing a torpedo through the ducts.

a. Use a torpedo having the same cross-sectional shape as the duct and that is a 1/4 inch smaller all around than the clear, nominal inside dimensions of the duct. Make no deductions to the torpedo section dimensions for tolerances allowed in the manufacture or fixing of the ducts.

b. For straight ducts, use a torpedo at least 2 feet long. For curved ducts, determine the length so that when both ends touch the outermost wall of the duct, the torpedo is 1/4 inch clear of the innermost wall. If the torpedo will not travel completely through the duct, the Engineer will reject the member, unless a workable repair can be made to clear the duct.

c. The torpedo must pass through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

d. Alternatively, for 4-strand tendons placed within flat ducts and used for transverse post-tensioning of precast segmental box girders, strands may be preplaced in the ducts prior to concrete casting.

(1) Prove that the post-tensioning ducts are free and clear of any obstructions or damage by moving the group of strands back and forth within the duct for a minimum distance of 1 foot in each direction.

(2) Ensure the strands are easily moveable within the duct by hand without the need for excessive effort or mechanical assistance. The time limit between initial placement of the strand and grouting of the stressed tendon as defined in Subsection 1.05.D begins when the strand is first placed in the duct.

3. Problems and Remedies: The Engineer will reject ducts or any part of the work found to be deficient. Perform no remedial or repair work without the Engineer's approval.

C. Installing Tendons: Flush ducts before placing the prestressing strands when the Engineer determines that the level of chloride contamination within ducts requires remediation. Flush ducts with potable water containing slack lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.17 lbs per gal. Test for the presence of chlorides and oils in the discharged water. Chlorides in the water must be less than 600 ppm. If chloride levels are in excess of 600 ppm, continue to flush the duct until the chloride level is below 250 ppm. Blow oil-free compressed air through the duct to remove any excess water in the duct.

1. Push or pull post-tensioning strands through the ducts to make up a tendon using methods which will not snag on any lips or joints in the ducts. Strands which are pushed should be rounded off at the end of the strand or fitted with a smooth protective cap. During the installation of the post-tensioning strand into the duct, the do not intentionally rotate the strand by any mechanical device. Provide sufficient strand length beyond dead end anchorages to allow for second end stressing as needed for reconciliation of jacking force versus measured elongation.

2. Alternatively, strands may be assembled to form the tendon and pulled through the duct using a special steel wire sock ("Chinese finger") or other device attached to the end. The ends of the strands may not be electric arc welded together for this purpose. Strands may be brazed together for pulling as long as 1 foot of strand from the brazed end is removed after installation. Round the end of the pre-assembled tendon for smooth passage through the duct. Cut strands using an abrasive saw or equal.

   a. Flame cutting is not allowed except for temporary tendons used to erect "locked" expansion joint segments in balanced cantilever.

3. Do not install permanent tendons before the completion of testing as required by these Specifications or Contract Drawings. The two exceptions to this requirement are:

   a. The tendon to be tested in the In Place Friction Test may be installed for the test.

   b. Transverse tendons may be preinstalled in precast segmental boxes prior to concrete casting as described above.

D. Post-Tensioning Operations

1. General: Do not apply post-tensioning forces until the concrete has attained the specified compressive strength as determined by cylinder tests. Conduct all stressing operations in the presence of the Engineer.

2. Stressing Tendons: Tension all post-tensioning steel with hydraulic jacks so that the post-tensioning force is not less than that required by the Contract Drawings or approved shop drawings, or as otherwise approved by the Engineer. Do not utilize mono strand jacks to stress tendons with five or more strands. The use of curved stressing noses or chairs is not permitted.

   a. Maximum Stress at Jacking: The maximum temporary stress (Jacking stress) in the post-tensioning steel must not exceed 80% of its specified minimum ultimate tensile strength. Do not overstress tendons to achieve the expected elongation.

   b. Initial and Permanent Stresses: The post-tensioning steel must be anchored at initial stresses that will result in the long term retention of permanent stresses or forces of no less than those shown on the Contract Drawings or the approved shop drawings. Unless otherwise approved by the Engineer, the initial stress after anchor set must not exceed 70% of the specified ultimate tensile strength of the post-tensioning steel at the anchorage.

Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post-tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages and all other losses peculiar to the post-tensioning system.

c. Stressing Sequence: Except as noted on the Contract Drawings or the approved shop drawings, permanent post-tensioning tendons must be stressed from both ends. The required force may be applied at one end and subsequently at the other end or simultaneously at both ends. Single end stressing is permitted when the following are satisfied:

(1) Space limitations prohibit double end stressing.

(2) The calculated elongation of the post-tensioning steel at the second end is 1/2 inch or less and wedges are power seated.

(3) Single end stressing applied at alternate ends of paired adjacent post-tensioning tendons is required to produce a symmetrical force distribution in agreement with the plan design.

d. For construction in stages where some tendons are required to be stressed before others, install and stress in accordance with the Contract Drawings or approved shop drawings or as otherwise approved by the Engineer.

3. Stressing Equipment: Only use equipment furnished by the supplier of the post-tensioning system (e.g., tendons, hardware, anchorages).

a. Stressing Jacks and Gauges: Each jack must be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge must have an accurate reading gauge with a dial at least 6 inches in diameter.

b. Calibration of Jacks and Gauges: Calibrate each jack and its gauges as a unit. The calibration must consist of three test cycles with the cylinder extension of the jack in various positions (e.g., 2 inch, 4 inch, 8 inch stroke). At each pressure increment, average the forces from each test cycle to obtain an average force. Perform the calibration with the equipment (e.g., jack, pump, hoses) setup in the same configuration that is intended to be used at the job site. The post-tensioning supplier or an independent laboratory shall perform initial calibration of jacks and gauges. Use load cells calibrated within the past 12 months to calibrate stressing equipment. For each jack and gauge unit used on the project, furnish certified calibration charts and curves to the Engineer prior to stressing. Supply documentation denoting the load cells calibration date and tractability to NIST (National Institute of Standards and Technology) along with the jack/gauge calibration.

(1) Provide the Engineer with certified calibration charts and curves prior to the start of the work and every six months thereafter, or as requested by the Engineer. Calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. Supply the master gauge to the Engineer in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. Provide a quick-attach hydraulic manifold to enable quick and easy installation of the master gauge to verify the permanent gauge readings. Calibrate and provide the master gauge to the Engineer. The master gauge will remain in the possession of the Engineer for the duration of the project.

c. Any jack repair, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration using a load cell. No extra compensation will be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

4. Elongations and Agreement with Forces: Ensure that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

   a. Measure elongations to the nearest 1/16 inch.

   b. For the required tendon force, the observed elongation must agree within 7% of the theoretical elongation or the entire operation must be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further.

      (1) Do not overstress the tendon to achieve the theoretical elongation.

   c. In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional tests for Tendon Modulus of Elasticity and In-Place Friction in accordance with Section 3.03.A.

5. Friction: The Contract Drawings were prepared based on the assumed friction and wobble coefficients, and anchor set noted on the Contract Drawings. Submit calculations and show a typical tendon force diagram, after friction, wobble and anchor set losses, on the shop drawings based upon the expected actual coefficients and values for the post-tensioning system to be used. Show these coefficients and values on the shop drawings.

   a. If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, revise post-tensioning operations so the final tendon force is in agreement with the Contract Drawings.

   b. When friction must be reduced, graphite may be used as a lubricant, subject to the approval of the Engineer.

6. Wire Failures in Post-Tensioning Tendons: Multi-strand post-tensioning tendons, having wires which fail, by breaking or slippage during stressing, may be accepted provided the following conditions are met:

   a. The completed structure must have a final post-tensioning force of at least 98% of the design total post-tensioning force.

   b. For precast segmental construction and for any similar construction that has members post-tensioned together across a common joint face, at any stage of erection, the post-tensioning force across a mating joint must be at least 98% of the post-tensioning required for that mating joint for that stage of erection.

   c. Any single tendon must have no more than a 5% reduction in cross-sectional area of post-tensioning steel due to wire failure.

   d. Any of the above conditions may be waived with approval of the Engineer, when conditions permit the Contractor to propose acceptable alternative means of restoring the post-tensioning force lost due to wire failure.

7. Cutting of Post-Tensioning Steel: Cut post-tensioning steel with an abrasive saw or plasma torch within 3/4 to 1-1/2 inches away from the anchoring device.

   a. Flame cutting of post-tensioning steel is not allowed except for cutting of temporary cantilever tendons used for erection of cantilevers with expansion joint segments.

b. Do not cut the tendon to final length until it has been accepted.

8. Record of Stressing Operations: Keep a record of the following post-tensioning operations for each tendon installed:

a. Project name, Project ID

b. Contractor and subcontractor

c. Tendon location, size and type

d. Date tendon was first installed in ducts

e. Reel number for strands and heat number for bars

f. Tendon cross-sectional area

g. Modulus of elasticity

h. Date Stressed

i. Jack and Gauge numbers per end of tendon

j. Required jacking force

k. Gauge pressures

l. Elongations (theoretical and actual)

m. Anchor sets (anticipated and actual)

n. Stressing sequence (i.e., tendons to be stressed before and after

o. Stressing mode (one end! two ends/ simultaneous)

p. Witnesses to stressing operation (Contractor and inspector)

q. Date grouted.

r. Record any other relevant information.

s. Provide the Engineer with a complete copy of all stressing and grouting operations.

E. Grouting Operations

1. Grouting Operations Plan: Submit a grouting operations plan for approval at least 6 weeks in advance of any scheduled grouting operations. Written approval of the grouting operations plan by the Engineer is required before any grouting of the permanent structure takes place. At a minimum, address and provide procedures for the following items:

a. Names and proof of training for the grouting crew and the crew supervisor in conformance with this specification

b. Type, quantity, and brand of materials used in grouting including all certifications required

c. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts

d. General grouting procedure

e. Duct pressure test and repair procedures

f. Method to be used to control the rate of flow within ducts

g. Theoretical grout volume calculations

h. Mixing and pumping procedures

i. Direction of grouting

j. Sequence of use of the inlets and outlet pipes

k. Procedures for handling blockages

l. Procedures for possible post grouting repair.

2. Grout Inlets and Outlets: Ensure that the connections from the grout pump hose to inlets are free of dirt and are air-tight. Inspect valves to be sure that they can be opened and closed properly.

3. Supplies: Before grouting operations start, provide an adequate supply of water and compressed air for clearing and testing the ducts, mixing and pumping the grout.

   a. Where water is not supplied through the public water supply system, a water storage tank of sufficient capacity must be provided.

4. Equipment

   a. General: Provide grouting equipment consisting of:

      (1) Measuring devices for water,

      (2) High-speed shear colloidal mixer,

      (3) Storage hopper (holding reservoir), and

      (4) Pump with all the necessary connecting hoses, valves, and pressure gauge.

      (5) Provide pumping equipment with sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption at the required rate of injection in not more than 30 minutes.

      (6) Provide an air compressor and hoses with sufficient output to perform the required functions. Provide vacuum grouting equipment (volumetric measuring type) and experienced operators within 48 hours notice.

   b. Mixer, Storage Hopper: Provide a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and undispersed cement.

      (1) The colloidal grout machinery will have a charging tank for blending and a holding tank. The blending tank must be equipped with a high shear colloidal mixer. The holding tank must be kept agitated and at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

      (2) Add water during the initial mixing by use of a flow meter or calibrated water reservoir with a measuring accuracy equal to one percent of the total water volume.

   c. Grout Pumping Equipment: Provide pumping equipment capable of continuous operation which will include a system for circulating the grout when actual grouting is not in progress.

      (1) Provide equipment capable of maintaining pressure on completely grouted ducts and fitted with a valve that can be closed off without loss of pressure in the duct.

      (2) Provide grout pumps that are a positive displacement type, and will provide a continuous flow of grout and be able to maintain a discharge pressure of at least 145 psi.

      (3) Use pumps with seals adequate to prevent oil, air or other foreign substances entering the grout and prevent loss of grout or water.

      (4) Provide a capacity sufficient to support an optimal rate of grouting.

      (5) Place a pressure gauge with a full scale reading of no more than 300 psi at the duct inlet. If long hoses (in excess of 100 feet) are used, place two gauges, one at the pump and one at the inlet.

(6) The diameter and rated pressure capacity of the grout hoses must be compatible with the pump output.

d. Vacuum Grouting Equipment: Provide vacuum grouting equipment consisting of the following:

(1) Volumeter for the measurement of void volume.

(2) Vacuum pump with a minimum capacity of 10 cfm and equipped with a flow-meter capable of measuring the amount of grout being injected.

(3) Manual colloidal mixers and/or dissolvers (manual high speed shear mixers), for voids less than 5.28 gallons in volume.

(4) Standard colloidal mixers, for voids 5.28 gallons and greater in volume.

e. Stand-by Equipment: During grouting operations, provide a stand-by colloidal grout mixer and pump.

5. Grouting

a. General: Perform a test to confirm the accuracy of the volume-measuring component of the vacuum grouting equipment each day when in use before performing any grouting operations. Use either water or grout for testing using standard testing devices with volumes of 0.5 gal. and 6.5 gal. and an accuracy equal to or less than 4 oz. Perform one test with each device.

(1) The results must verify the accuracy of the void volume-measuring component of the vacuum grouting equipment within 1 % of the test devise volume and must verify the accuracy of the grout volume component of the vacuum grouting equipment within 5% of the test devise volume. Ensure the Engineer is present when any test is performed.

(2) Grout tendons in accordance with the procedures set forth in the approved grouting operation plan.

(3) Grout all empty ducts.

b. Temperature Considerations

(1) Maximum grout temperature must not exceed 90 deg. F at the grout inlet.

(2) Use chilled water and/or pre-cooling of the bagged material to maintain mixed grout temperature below the maximum allowed temperature.

(3) Grouting operations are prohibited when the ambient temperature is below 40 deg. F or is 40 deg. F and falling. Postpone grouting operations if freezing temperatures are forecasted within the next 2 days and it is expected the concrete temperature surrounding the duct will fall below 40 deg. F.

c. Mixing and Pumping: Mix the grout with a metered amount of water. Mix the materials to produce a homogeneous grout. Continuously agitate the grout until grouting is complete. Reject bags of grout that contain clumps.

d. Grout Production Test: During grouting operations, the fluidity of the grout must be strictly maintained within the limits established by the grout manufacturer. A target fluidity rate will be established by the manufacturer's representative, based on ambient weather conditions. Determine grout fluidity by use of either test method based on ASTM C939 found in Subsection 2.02.B.5.b.

(1) Perform fluidity test at a frequency specified in Subsection 3.02.E.5.e and maintain the correct water to cementitious ratio. Do not use grout which tests outside the allowable flow rates.

(2) Prior to grouting empty ducts, condition the grout materials as required to limit the grout temperature at the inlet end of the grout hose to 90 deg. F.

(3) Prior to performing repair grouting operations with vacuum grouting, condition the grout materials to limit the grout temperature at the inlet end of the grout hose to 85 deg. F. Check the temperature of the grout at the inlet end of the grout hose hourly.

(4) At the beginning of each day's grouting operation, obtain a representative sample of grout from the first production batch of grout and perform a wick induced bleed test in accordance with Subsection 2.02.B.5.b using this sample. Begin grouting operations after the sample is obtained. If zero bleed is not achieved in the wick induced bleed test at any time during the required test time period, complete the grouting of any partially grouted tendons and do not begin grouting of any new or additional tendons until the grouting operations have been adjusted and further testing shows the grout meets the specified requirements.

e. Grout Operations: Open all grout outlets before starting the grouting operation. Grout tendons in accordance with the Grouting Operations Plan.

(1) Unless approved otherwise by the Engineer, pump grout at a rate of 16 feet to 50 feet of duct per minute.

(a.) Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at the grout inlet.

(b.) Do not exceed the maximum pumping pressure of 145 psi at the grout inlet for round ducts and 75 psi for flat ducts in deck slabs.

(2) Use grout pumping methods which will ensure complete filling of the ducts and complete encasement of the steel. Grout must flow from the first and subsequent outlets until any residual water or entrapped air has been removed prior to closing the outlet.

(3) Pump grout through the duct and continuously discharge it at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped into the inlet.

(a.) Close the anchorage outlet and discharge a minimum of 2 gallons of grout from the grout cap into a clean receptacle.

(b.) Close the grout cap outlet.

(4) For each tendon greater than 50 feet in length, immediately after uncontaminated uniform discharge begins, perform a fluidity test using the flow cone on the grout discharged from the grout cap outlet.

(a.) For tendons 50 feet and less, perform a fluidity test on a per batch basis. For fluidity tests done on a per batch basis, perform the test after the new batch has been transferred from the mixing tank to the holding tank and thoroughly mixed with the remains of the previous batch to produce a new homogenous mixture.

(5) During the mixing process, continually re-circulate the grout from the hose into the holding tank. The measured grout efflux time will not be less than the efflux time measured at the injection end of the grout hose.

(a.) Alternately, check the grout fluidity using the Wet Density method contained in Subsection 2.02.B.5.b. The density at the final outlet must not be less than the grout density at the inlet. If the grout fluidity is not acceptable, discharge additional grout from the anchorage outlet and test the grout fluidity.

(6) Continue this cycle until an acceptable grout fluidity is achieved. Discard grout used for testing fluidity. After all outlets have been bled and sealed, elevate the grout pressure to approximately 75 psi , seal the inlet valve and wait two minutes to determine if any leaks exist.

(a.) If leaks are present, fix the leaks using methods approved by the Engineer. Repeat the above stated process until no leaks are present. If no leaks are present, bleed the pressure to 5 psi and wait a minimum of 10 minutes for any entrapped air to flow to the high points. After the minimum 10 minute period has expired, increase the pressure as needed and discharge grout at each high point outlet to eliminate any entrapped air or water.

(b.) Complete the process by locking a pressure of 30 psi into the tendon.

(7) If the actual grouting pressure exceeds the maximum allowed, the inlet will be closed and the grout will be pumped at the next outlet, which has just been, or is ready to be closed as long as a one-way flow is maintained.

(a.) Grout will not be pumped into a succeeding outlet from which grout has not yet flowed. If this procedure is used, the outlet/inlet, which is to be used for pumping will be fitted with a positive shut-off and pressure gage.

(8) When complete grouting of the tendon cannot be achieved by the steps stated herein, stop the grouting operation. After waiting 48 hours, fill the tendon with grout in accordance with the procedure outlined in Subsection 3.03.B.1.f.

f. Vertical Grouting: For all vertical tendons, including superstructure web tendons, provide a standpipe at the upper end of the tendon to store bleed water and grout, maintain the grout level above the level of the prestressing plate and anchorage. Design and size this device to maintain the level of the grout at an elevation which will assure that bleeding will at no time cause the level of the grout to drop below the highest point of the upper anchorage device. Design the standpipe to allow all bleed water to rise into the standpipe, not into the uppermost part of the tendon and anchorage device.

(1) Discharge grout and check grout fluidity as described in Subsection 3.02.E. As grouting is completed, the standpipe will be filled with grout to a level which assures that, as settlement of the grout occurs, the level of the grout will not drop below the highest point in the upper anchorage device. If the level of the grout drops below the highest point in the anchorage device, immediately add grout to the standpipe. After the grout has hardened, the standpipe will be removed. In the presence of the Engineer, visually inspect for voids using an endoscope or probe. Fill all voids found in the duct using volumetric measuring vacuum grouting processes.

(2) For vertical tendons in excess of 100 feet or if the grouting pressure exceeds the maximum recommended pumping pressure, then grout will be pumped at increasingly higher outlets which have been or are ready to be closed as long as a one-way flow of grout is maintained. Grout will be allowed to flow from each outlet until all air and water have been purged prior to using that outlet for pumping.

g. Flushing of grout is not permitted unless approved by the Engineer. Vacuum grouting is required to repair all voids and blockages as defined in Subsection 3.03.B.1. Flushing of ducts is only permitted as defined in Subsection 3.02.C.

h. Except when waived by the Engineer in writing, failure to grout tendons within the calendar days specified will result in stoppage of the affected work in accordance with the provisions of Division 1.

F. Forming and Repairs of Holes and Block-Outs.

1. Repair of Lifting and Access Holes: Repair all holes with Magnesium Ammonium Phosphate Concrete meeting the requirements of Subsection 2.02.D. Within 24 hours prior to casting the concrete, mechanically clean and roughen the mating concrete surfaces to remove any laitance and expose the small aggregate.

   a. Grit blasting or water blasting using a minimum 10,000 psi nozzle pressure is required. Flush surface with water and blow dry.

   b. Form, mix, place and cure the material in strict compliance with the manufacturer's recommendations.

   c. Coat the repaired holes, block-outs and an area extending 6 inches outside the perimeter of the repair with a High Molecular Weight Methacrylate (HMWM). Prepare the surface to be coated and apply the HMWM in accordance with the manufacturer's instructions. Friction (skid) tests are not required.

   d. Alternately, an epoxy grout may be used for the repair material. Epoxy grout shall be:

      (1) E3HP Epoxy Grout manufactured by Euclid Chemical

      (2) Sikadur 42 Grout Pak PT manufactured by Sika Corporation

      (3) Magmaflow Grout-Pak manufactured by Pilgrim Permocoat Inc.

      (4) Or approved equal.

2. Repair of Grout Inlets and Outlets: Place threaded plastic caps in all inlet/outlet locations required in the Contract Drawings. Repair inlets/outlets as shown on the Contract Drawings using an epoxy grout. Epoxy grout shall be:

   a. Sikadur 35 Hi-Mod LV manufactured by Sika Corporation

   b. UWC (LV) manufactured by Pilgrim Permocoat Inc

   c. Concresive Standard LVI manufactured by BASF C C Building Systems

   d. Or approved equal

   Prepare the surface to receive the epoxy material in strict compliance with the manufacturer's recommendations.

G. Crack Repair

1. Equipment: Apply the material according to the manufacturer's specifications using mobile equipment capable of distributing material on large areas of decks and riding surfaces.

   a. Apply the material by hand using adequate containers for isolated or localized applications.

2. Mixing: Mix the methylmethacrylate material following the manufacturer's specified mixing proportions for the catalysts. Perform the initial mixing by equally dividing the resin to be used into two separate containers. In all instances, mix the initiator (CHP) at the HMWM manufacturer's specified volume with 50% of the monomer resin in one container and the cumene promoter at the HMWM manufacturer's specified volume with the other 50% in the second container.

After properly blending, combine the two resins and mix as per manufacturer's instructions. For spray bar application, mix the activator/resin blend and the promoter/resin blend through a static mixer in the feed line located ahead of the material distribution bars where polymerization would start. Calibrate the valves to the static mixer to ensure a one to one mixing ratio of the two blends.

3. Polymer Application (Mobile Distribution): Apply the material only under weather conditions recommended by the manufacturer and when no rainfall has occurred during the previous 48 hours and no rain is expected for the next 6 hours following completion of the application.

   Unless otherwise approved by the Engineer, distribute the monomer uniformly over the work area using a pressure nozzle or spray head distribution bar system. Provide feed to the distribution bars using positive displacement pumps moving equal amounts of the two monomer blends from two calibrated drums.

   a. Calibrate the equipment to mix the two monomer blends to the recommended ratio (by volume) within ±5%. The discharge volume shall be calibrated to the moving speed to provide a discharge rate capability ranging from 50 to 200 square feet per gallon at a pressure ranging from 15 to 60 psi.

   b. The typical application rate of the material is approximately 100 square feet per gallon. Prior to application of the monomer, the Engineering Materials Unit will determine the final production application rate based on the internal characteristics of the cracks as determined from Contractor supplied cores that the Engineer approves as being representative of the overall cracking conditions.

4. Polymer Application (Localized Distribution): Distribute the material by hand over the work area using pails or other suitable containers adequate for the size of the area. This only applies to localized small areas or areas where the use of mobile distribution equipment would be considered impractical as approved by the Engineer.

   a. Apply the material only under weather conditions recommended by the manufacturer and on areas that have been maintained dry for a minimum of 48 hours: Ensure that the area remains dry for the next 6 hours following completion of the application.

5. Sealing of Cracks: Regardless of the method used to apply the material over the concrete surface, work the material back and forth over the cracks to maximize the amount of material to be absorbed by the cracks.

   a. Move the material over the cracks using brooms, squeegees or paint brushes as appropriate, based on the size of the area. Commence this operation immediately after distributing the material on the concrete surface. Continue this operation until no additional material is flowing inside the cracks or the material begins to exhibit signs of polymerization.

   b. Do not distribute material over areas larger than what the available personnel can effectively work over the cracks within the limits of the pot life.

6. Sand Distribution: Apply sand over the monomer treated area within a timely period following the application of the polymer based on the manufacturer's recommendations for the existing conditions. Use equipment that will produce a uniform distribution of the sand over the treated area. If wheel mounted, use a sand spreader that has pneumatic tires compatible with the treatment material such that no tire footprints are left on the deck surface.

a. Use an initial application rate of 0.6 (±0.05) pounds of sand per square yard of treated area, and adjust the rate as necessary to produce a skid number (SN) of no less than 25 at 24 hours and 30 at 7 days. Coordinate with the Engineer to conduct a preliminary on-site skid test to determine the actual sand application rate prior to the beginning of production application. If friction numbers below those specified are obtained, completely remove all loose sand from the surface and re-apply the polymer at a rate of 150 square feet per gallon and spread additional sand as necessary to achieve the specified skid numbers.

Remove the surface material by grinding or other approved method if satisfactory friction values are not achieved. Friction tests will be conducted by the Authority.

7. Opening Riding Surfaces to Traffic: Protect the sand covered area from vehicular traffic until the polymer has fully cured. After curing, power vacuum to remove excess sand from the riding surface, before opening to traffic.

8. Cure Test: Test curing on the treated area using a cotton strand or cotton ball. Consider the material fully cured and ready for traffic when polymer does not adhere to the cotton ball when pressed against the treated surface and then pulled away. Obtain approval from the Engineer prior to reopening area to traffic.

3.03 FIELD QUALITY CONTROL

A. Field Tests

1. Tendon Modulus of Elasticity Test: If required in the Contract Documents or ordered by the Engineer, perform a tendon modulus of elasticity test in accordance with the following procedure.

a. For the purpose of accurately determining the tendon elongations while stressing, bench test two samples of each size of tendon to determine the modulus of elasticity prior to stressing the initial tendon.

b. For the purpose of this test, the bench length between anchorages must be at least 40 feet and the tendon duct at least 2 inches clear of the tendon all around. The test procedure must consist of stressing the tendon at an anchor assembly with a J Load cell at the dead end.

(1) Tension the test specimen to 80% of ultimate in ten increments and then detention from 80% of ultimate to zero in ten decrements. For each increment and decrement, record the gauge pressure, elongations and load cell force. Note elongations of the tendon for both ends and the central 30 feet, measured to an accuracy of plus or minus 1/32 inch. Correct the elongations for the actual anchorage set of the dead end.

Calculate the modulus as follows:

$$E = (P\,L)/(A\,\Delta)$$

where :

P = force in tendon,

L = distance between pulling wedges and dead end wedges or exact length in center 30 feet of the tendon.

A = cross-sectional area of the tendon based on nominal area.

Δ = strand elongation for load P.

c. If the bench test varies from the modulus of elasticity used for the shop or working drawings by more than 1 %, submit revisions to the theoretical elongations to the Engineer for approval.

d. When the observed elongations of the tendons in the erected structure fall outside the acceptable tolerances, or to otherwise settle disputes, additional Tendon Modulus of Elasticity Tests may be required to the satisfaction of the Engineer.

e. If the source of prestressing steel changes during the project, additional test series or substantiation from previous projects, not to exceed two per source will be required. The apparatus and methods used to perform the test must be submitted to the Engineer for approval. Tests must be conducted in the Engineer's presence.

2. In Place Friction Test: For tendons in excess of 100 feet long, test in place a minimum of one tendon in each tendon group performing the same function. Functional tendon groups are cantilever tendons, continuity tendons, draped external tendons or continuous profiled tendons passing through one or more spans. The selected tendon will represent the size and length of the group of tendons being tested.

a. The test procedure consists of stressing the tendon at an anchor assembly with a load cell or a second certified jack at the dead end.

(1) Stress the test specimen to 80% of ultimate tendon strength in eight equal increments. For each increment, record the gauge pressure, elongations and load cell force. Take into account any wedge seating in both the live end (i.e., back of jack) and the dead end (i.e., back of load cell) and any friction within the anchorages, wedge plates and jack as a result of slight deviations of the strands through these assemblies.

(2) For long tendons requiring multiple jack pulls with intermediate temporary anchoring, keep an accurate account of the elongation at the jacking end allowing for intermediate wedge seating and slip of the jack's wedges.

b. If the elongations fall outside the plus or minus 5% range compared to the anticipated elongations, investigate the reason and make detailed calculations confirming the final tendon forces are in agreement with the requirements of the approved Contract Drawings.

c. In reconciling theoretical and actual elongations, do not vary the value of the expected friction and wobble coefficients by more than plus or minus 10%.

(1) Significant shortfall in elongations is indicative of poor duct alignments and/or obstructions. Correct or compensate for such elongations in a manner proposed by the Contractor and reviewed and approved by the Engineer at no additional cost to the Authority.

d. The Engineer will require one successful friction test for each tendon group for the project.

e. If there are irreconcilable differences between forces and elongations, or other difficulties during the course of routine stressing operations, the Engineer may require additional in place friction tests.

f. The apparatus and methods used to perform the test must be submitted to the Engineer for approval. Tests must be conducted in the Engineer's presence.

3. Tests Reports Required:

a. Submit two test reports of the Tendon Modulus of Elasticity Test to the Engineer at least 30 days before installing the tendon.

b. Submit two test reports of the In Place Friction Test to the Engineer within two weeks after successful installation of the tested tendon.

c. Application of Test Results: Reevaluate the theoretical elongations shown on the post-tensioning shop or working drawings using the results of the tests for Tendon Modulus of Elasticity and In Place Friction as appropriate and correct as necessary. Submit revisions to the theoretical elongations to the Engineer for approval.

4. Internal Duct Pressure Test: Pressure test each different type and size of duct assembly at the site of casting before its first time use on the project. Pressure test all assemblies used in a single component constructed for the first time on the project, and thereafter, in groups of not more than 50 components, the Engineer shall randomly select one component per group, but not less than a total of two per project, for testing. Types of components include all post-tensioned components including but not limited to transversely post-tensioned slabs, longitudinally post-tensioned girders, post-tensioned box girder segments, pier and bent caps, and columns.

   a. Longitudinal tendons in box segments are exempt from this testing.

   b. Test the assemblies in their final position just prior to concrete placement by sealing them at their anchorage or construction joint termini and then by applying compressed air to determine if the assembly connections are pressure tight.

      (1) In the presence of the Engineer, pressurize the duct to 1.5 psi and lock-off the outside air source then record the pressure loss for a duration of one minute.

      (2) If the pressure loss exceeds 0.15 psi, find and repair the leaks in the duct assembly using repair methods approved by the Engineer and retest.

5. Duct Pressure Field Test: After stressing and before grouting internal or external tendons, install all grout caps, vents and outlets and test the tendon with compressed air to determine if duct connections require repair.

   In the presence of the Engineer, pressurize the tendon to 50 psi and lock-off the outside air source. Record pressure loss for one minute. A pressure loss of 25 psi is acceptable for tendons having a length of equal to or less than 150 feet and a pressure loss of 15 psi is acceptable for tendons longer than 150 feet.

   If the pressure loss exceeds the allowable, repair leaking connections using methods approved by the Engineer and retest.

6. System Test Requirements: For each family of post-tensioning systems, assemble systems and perform the pressure test defined herein. For each family of post-tensioning systems, test two assemblies (largest and smallest) from the family. The post-tensioning assembly includes at least one of each component required to make a tendon from grout cap to grout cap. If applicable, include plastic duct to steel pipe connections and segment duct couplers.

   a. Grouting Component Assembly Pressure Test: Assemble anchorage and grout cap with all required grouting attachments (grout tube, valves, plugs, etc.). Seal the opening in the anchorage where the duct connects. Condition the assembly by maintaining a pressure of 150 psi in the system for 3 hours.

      After conditioning, the assembly must sustain a 150 psi internal pressure for five minutes with no more than 15 psi reduction in pressure. For systems using the same anchorages, grout caps and grouting attachments as a previously approved system, the Grouting Component Assembly Pressure Test may include documentation from a previous submittal with written certification that the same components are being utilized in both anchorages.

b. Internal Duct Systems: Perform a system test of the assembly for compliance with the requirements of Chapter 4, Article 4.2, Stage 1 and Stage 2 Testing contained in FIB Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-Tensioning". For bar systems modify the system test length to 15 feet. For systems being tested for use in precast segmental construction, modify this test to include one duct coupler (or O-ring assembly) which is to be used at the segment joint.

c. Duct Coupler: Test the coupler for proper function by casting the coupler into a two part concrete test block using match cast techniques. Use blocks that are at least 12 inches x 12 inches x 12 inches. After the concrete has hardened, pull the blocks apart and clean the surface of any bond breaker materials. Using an external apparatus, clamp the blocks together and maintain 40 psi pressure on the block cross section during the pressure test.

(1) Do not apply epoxy between the blocks for this portion of the test. Pressurize the duct within the test block to 5 psi and lock-off the outside air source.

(2) The assembly must sustain a 5 psi internal pressure for five minutes with no more than a 0.5 psi reduction in pressure.

(3) Separate the duct coupler blocks from the duct system remove the clamping device and place a 1/16 inch layer of epoxy on the face of both blocks, clamp the blocks together and maintain a pressure of 40 psi on the block cross section for 24 hours.

(4) Upon removal of the clamping force, demolish the blocks. The coupler and the attached ducts should be intact and free of epoxy, and properly attached without crushing, tearing or other signs of failure.

B. Inspections

1. Post Grouting Operations and Inspection

a. Do not remove or open inlets and outlets until the grout has cured for 24 to 48 hours.

b. Remove all outlets located at anchorages and high points along the tendon to facilitate inspection and perform inspections within 1 hour after the removal of the inlet/outlet.

c. Drill and inspect all high points along the tendon as well as the inlets or outlets located at the anchorages. Depending on the geometry of the grout inlets, drilling may be required to penetrate to the inner surface of the trumpet or duct.

(1) Use drilling equipment that will automatically shut-off when steel is encountered.

(2) Unless grout caps are determined to have voids by sounding, do not drill into the cap. Perform inspections in the presence of the Engineer using endoscopes or probes.

(3) If voids are detected in tendon ducts or anchorages during inspection, fill voids using the volumetric measuring vacuum grouting process within 48 hours.

(4) If no voids are detected in tendon ducts or anchorages, seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes as specified in Subsection 3.02.F.2 within 4 hours of completion of the inspections.

(5) Remove the inlet/outlet to a minimum depth of 2 inches. Use an injection tube to extend to the bottom of the drilled holes for backfilling with epoxy.

d. Seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes as specified in Subsection 3.02.F.2. Remove the inlet/outlet to a minimum depth of 2 inches. Use an injection tube to extend to the bottom of the drilled holes for backfilling with epoxy.

e. Post grouting inspection of tendons having a length of less than 150 feet may utilize the following statistical frequency for inspection:

(1) For the first 20 tendons, inspect all outlets located at anchors and tendon high points by drilling and probing with an endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), continue testing all tendons until 20 consecutive tendons have been inspected and no voids have been found.

(2) When no defects are detected as defined in Step (1) above, the frequency of inspection can be reduced to inspect every other tendon (50%). If a defect is located, inspect the last five tendons grouted. Return to Step (1) above, and renew the cycle of 100% tendon inspection.

f. If tendon grouting operations were prematurely terminated prior to completely filling the tendon, drill into the duct and explore the voided areas with an endoscope. Probing is not allowed. Determine the location and extent of all voided areas. Install grout inlets as needed and fill the voids using volumetric measuring vacuum grouting equipment.

g. Grouting Report: Provide a grouting report signed by the Contractor and/or the Subcontractor within 72 hours of each grouting operation for review by the Engineer.

(1) Report the theoretical quantity of grout anticipated as compared to the actual quantity of grout used to fill the duct. Notify the Engineer immediately of shortages or overages.

(2) Information to be noted in the records must include but not necessarily be limited to the following: identification of the tendon; date grouted; number of days from tendon installation to grouting; type of grout; injection end and applied grouting pressure; ratio of actual to theoretical grout quantity; number of bags of grout mixed; total quantity of water used to mix the grout; summary of any problems encountered and corrective action taken.

3.04 PROTECTING

A. Protection of Post-Tensioning Anchorages

1. Within 7 days upon completion of the grouting, protect the anchorage of post-tensioning bars and tendons as indicated in the Contract Drawings. The application of the elastomeric coating may be delayed up to 90 days after grouting. Plug all grout inlets/outlets with plugs meeting the requirements of Subsection 2.02.H.4.

a. Use an epoxy grout to construct all pour-backs located at anchorages. Epoxy grout shall be:

(1) E3HP Epoxy Grout manufactured by Euclid Chemical

(2) Sikadur 42 Grout Pak PT manufactured by Sika Corporation

(3) Magmaflow Grout-Pak manufactured by Pilgrim Permocoat Inc.

(4) Or approved equal.

2. Remove all laitance, grease, curing compounds, surface treatments, coatings and oils by grit blasting or water blasting using a minimum 10,000 psi nozzle pressure. Flush surface with water and blow dry. Surfaces must be clean, sound and without any standing water. In case of dispute, use ACI 503 for substrate testing and develop a minimum of 175 psi tension (pull-off value).

3. Mix and apply epoxy as per manufacturer's current standard technical guidelines. Construct all pour-backs in leak proof forms creating neat lines. The epoxy grout may require pumping for proper installation. Construct forms to maintain a liquid head to insure intimate contact with the concrete surface. Use vents as needed to provide for the escape of air to insure complete filling of the forms.

4. Coat the exposed surfaces of all pour-backs and grout caps with an elastomeric coating system meeting the requirements of Subsection 2.02.E and having a thickness of 30 to 45 mils. Assure concrete, grout caps or other substrates are structurally sound, clean and dry. Concrete must be a minimum of 28 days old.

   a. Remove all laitance, grease, curing compounds, surface treatments, coatings and oils by grit blasting or water blasting using a minimum 10,000 psi nozzle pressure to establish the anchor pattern. Blow the surface with compressed air to remove the dust or water.

B. Grout: Construction Traffic and Operations Causing Vibrations: During grouting and for a period of 4 hours upon completion of grouting, eliminate vibrations from all sources such as moving vehicles, jackhammers, compressors, generators, pile driving operations, soil compaction, etc., that are operating within 300 feet down-station and 300 feet up-station of the ends of the span in which grouting is taking place.

END OF SECTION

SECTION 03250

POST-TENSIONING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings - Structural: Prepare shop drawings to address all requirements stated in the Contract Drawings and the requirements stated herein. Indicate the approved post-tensioning systems to be used.

1. Show tendon geometry and locations complying with the Contract Drawings and the limitations of the selected post-tensioning system.
2. Show all:
   a. Inlets and outlets,
   b. High point outlet inspection details,
   c. Anchorage inspection details,
   d. Permanent grout caps,
   e. Protection system materials and application limits.

B. Shop Drawings – Post-Tensioning System: Strand

1. Typical Strand Patterns/Strand Areas
2. Anchorage Hardware
3. Ducts and Duct Couplers
4. Grout Caps
5. Grout Accessories

C. Shop Drawings – Post-Tensioning System: Bar

1. Typical Bar Sizes/Areas
2. Anchorage Hardware
3. Bar Couplers
4. Ducts and Duct Couplers
5. Grout Caps
6. Grout Accessories

D. Shop Drawings

1. Tendon Modulus of Elasticity Test
2. In-Place Friction Test
3. Internal Duct Pressure Test
4. Test Block for Protection of Post-Tensioning Anchorages (Elastomeric Coating)
5. Corrugated Plastic Duct
6. Grouting Operations Plan

E. Calculations
   1. Tendon elongations

F. Product Data
   1. Grout Mixer and Pump
   2. Epoxy Grout

G. Samples
   1. Steel strand
   2. Steel bar

H. Certificates
   1. Certified Calibration Charts for All Post-Tensioning Jacks

I. Manufacturer Test Reports
   1. Post-tensioning system: Strand
   2. Post-tensioning system: Bar
   3. Post-tensioning Grout
   4. Epoxy Resin Compounds (Anchorage Protection)
   5. Magnesium Ammonium Phosphate Concrete
   6. Elastomeric Coating System
   7. Methacrylate System

J. Construction and Installation Procedures
   1. Measurement Method for Elongation including Anchor Set
   2. Crack Sealer Application Plan

K. Qualifications
   1. Specialty Engineer
   2. Crew Foreman: Post-Tensioning
   3. Crew Foreman: Grouting

L. Record Documents
   1. Prestressing Steel (LOT and Heat number)
   2. Quality Control Data Sheet – Grout (by LOT and Shipment)
   3. Records of Stressing Operations
   4. Grouting Report

M. Material Tests
   1. Magnesium Ammonium Phosphate Concrete

END OF APPENDIX "A"

DIVISION 3

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

PART 1. GENERAL

1.01 SUMMARY

This Section and its appendices specify requirements for Portland Cement Concrete mix proportions, materials used in concrete mixes, placing, finishing, curing, control joints, end result property requirements of the in-place concrete, and the evaluation of these properties through Quality Acceptance testing performed by the Authority for determining Adjustments to Contract Compensation. The Specifications herein establish minimum standards for concrete construction. This does not relieve the Contractor from following more stringent standards to achieve the quality acceptance limits for applicable performance parameters and their respective Percent Within Limit (PWL) measurements.

1.02 REFERENCES

A. References: The following is a listing of the publications, standards and codes referenced in this Section, of which the latest edition shall govern:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO LRFD	LRFD Bridge Design Specifications (6th Edition, 2012)
AASHTO M182	Burlap Cloth Made From Jute or Kenaf.
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete.
AASHTO T 277	Electrical Indication of Concrete's Ability to Resist Chloride.
AASHTO T 318	Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

American Concrete Institute (ACI)

ACI 207	Mass Concrete.
ACI 211	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
ACI 211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
ACI 213	Guide for Structural Lightweight-Aggregate Concrete.
ACI 222R	Protection of Metals in Concrete Against Corrosion.
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 302.1	Guide for Concrete Floor and Slab Construction.
ACI 303.1	Specification for Cast in Place Architectural Concrete.
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete. Chapter 8: Concrete Placed Under Water.
ACI 305R	Hot Weather Concreting.
ACI 306R	Cold Weather Concreting.
ACI 308	Standard Practice for Curing Concrete.

ACI 309R	Guide for Consolidation of Concrete.
ACI 318	Building Code Requirements for Structural Concrete.
ACI 548.4	Standard Specification for Latex-Modified Concrete (LMC) Overlays.

ASTM International (ASTM)

ASTM C31	Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C33	Specification for Concrete Aggregates.
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C42	Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
ASTM C78	Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTM C94	Specification for Ready-Mixed Concrete.
ASTM C114	Test Methods for Chemical Analysis of Hydraulic Cement.
ASTM C131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
ASTM C143	Test Method for Slump of Hydraulic-Cement Concrete.
ASTM C150	Specification for Portland Cement.
ASTM C156	Test Method for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete.
ASTM C157	Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
ASTM C171	Specification for Sheet Materials for Curing Concrete.
ASTM C172	Practice for Sampling Freshly Mixed Concrete.
ASTM C173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
ASTM C174	Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
ASTM C191	Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
ASTM C227	Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method. (Do not use for lightweight concrete; see instead C173)
ASTM C260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C289	Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
ASTM C309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C311	Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans

	for Use in Portland-Cement Concrete.
ASTM C330	Specification for Lightweight Aggregates for Structural Concrete.
ASTM C494	Specification for Chemical Admixtures for Concrete.
ASTM C496	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C566	Test Method for Total Evaporable Moisture Content of Aggregate by Drying.
ASTM C567	Test Method for Determining Density of Structural Lightweight Concrete.
ASTM C618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C979	Specification for Pigments for Integrally Colored Concrete.
ASTM C989	Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.
ASTM C1116	Specification for Fiber-Reinforced Concrete.
ASTM C1152	Test Method for Acid-Soluble Chloride in Mortar and Concrete.
ASTM C1218	Test Method for Water-Soluble Chloride in Mortar and Concrete.
ASTM C1240	Specification for Silica Fume Used in Cementitious Mixtures.
ASTM C1260	Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
ASTM C1399	Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.
ASTM C1583	Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials By Direct Tension (Pull-Off Method).
ASTM C1611	Slump Flow of Self-Consolidating Concrete.
ASTM C1621	*Standard Test Method for Passing Ability of Self-Consolidating* Concrete by J-Ring
ASTM D1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
ASTM D1752	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
ASTM D3665	Practice for Random Sampling of Construction Materials.
ASTM D4580	Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
ASTM D4791	Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
ASTM D4833	Test Method for Index Puncture Resistance of Geomembranes, and Related Products.

ASTM D5199	Test Method for Measuring the Nominal Thickness of Geosynthetics.
ASTM E965	Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique.
ASTM E1347	Test Method for Color and Color-Difference Measurement by Tri-stimulus (Filter) Colorimetry.

New Jersey Department of Transportation (NJDOT)

Standard Specifications for Road and Bridge Construction 2007.

US Army Corps of Engineers (USACE)

Handbook of Concrete and Cement.

B. Modifications to References for Lightweight Concrete

1. ASTM C131: Modify C131 testing procedures to use a "volume" of lightweight aggregate equal to the "volume" of the specified mass of charge for normal weight aggregate.
2. ASTM C666: Modify C666 testing procedures for freeze-thaw testing as specified in ASTM C330 for lightweight concrete.

C. Definitions

1. AASHTO Materials Reference Laboratory: AMRL
2. Cement and Concrete Reference Laboratory: CCRL

1.03 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements

1. Cold weather concrete construction shall conform to ACI 306R.
2. Submit a Cold Weather Concrete Construction Plan, and have it approved prior to concrete placements when the ambient temperature falls below 50 deg F. This Plan shall conform to ACI 306R and shall include but not be limited to the demonstration of how the in situ concrete temperature will be maintained at 50 deg F and monitored, or at temperatures specified in ACI 306R, Table 3.1, whichever is more stringent. Include specific measures that will be taken for lightweight concrete. In addition, demonstrate that the specified concrete properties can be achieved within the time requirements specified while maintaining a minimum curing temperature of 50 deg F.
3. Do not mix or place concrete when the ambient temperature is below 35 deg F, or when conditions indicate that the temperature will fall below 35 deg F within 72 hours, unless the areas to receive fresh concrete are insulated or enclosed, and maintain the concrete temperature at 50 deg F or in accordance with Table 3.1 in ACI 306. Any concrete that shows to be damaged due to freeze-thaw as determined by the Engineer shall be removed and replaced.
4. Reinforcement, forms and soils with which concrete will be in contact shall not be frozen and must be maintained completely frost-free. If required, apply heat to raise their temperature to a minimum of 35 deg F. The use of chemicals to eliminate frost will not be permitted.

5. All lightweight concrete must be maintained at a minimum of 50 deg F at all times until the design strength is reached.

B. Any precast lightweight concrete must be stored at a minimum temperature of 50 deg F for a minimum of 30 days before subjected to freeze-thaw. Hot Weather Requirements

1. Hot weather concrete construction shall conform to ACI 305R.

2. Submit a Hot Weather Concrete Construction Plan and have it approved prior to concrete placements when the ambient temperature exceeds 80 deg F. This Plan shall conform to ACI 305R and shall include but not be limited to the demonstration of how the concrete temperature during batching and mixing will be kept below 90 deg F, how the concrete will be protected from rapid evaporation of surface moisture, the proper use of water reducing retarders with re-dosing charts and procedures and curing procedures.

3. Do not place concrete for pavements, overlays, bridge decks or ramps when the ambient temperature exceeds 85 deg F; schedule Work so that concrete can be placed during the coolest part of the day. Do not place concrete for structural decks, slabs or pavements when the rate of concrete surface evaporation exceeds 0.15 lbs/ft^2/hr, as defined in ACI 305R, Figure 2.1.5. If ambient conditions exceed this limit, demonstrate through the use of windscreens, fogging or other suitable means that the concrete evaporation rate is less than 0.15 lbs/ft^2/hr.

4. If the concrete temperature reaches 92 deg F as measured at the construction site in accordance with ASTM C1064, it may be rejected.

1.04 QUALITY CONTROL

A. General

1. Maintain a level of Quality Control sufficient to consistently achieve the end result performance properties specified herein. In addition:

a. Submit the approved mix proportions including an automated, time-date stamp on each delivery ticket indicating the batch weights of all batching constituents.

b. Ensure that all plant mixing equipment and trucks are calibrated and approved by either the New Jersey or New York State Department of Transportation. Documentation of such conformance shall be available to the Engineer at all times.

c. Ensure that all personnel performing concrete testing are certified ACI Grade I Concrete Laboratory Testing Technicians or Concrete Field Testing Technicians, as appropriate.

d. Ensure the independent testing laboratory employed to perform field and laboratory testing is AMRL and CCRL certified.

B. Quality Control Plan: Submit a Quality Control Plan a minimum of 10 days prior to the pre-concrete construction meeting described in 1.06. Do not start production before the Quality Control Plan has been approved by the Engineer. The Quality Control Plan shall include the following:

1. Quality Control Organization

a. A chart showing all Quality Control personnel and a description of how these personnel integrate with and report to other management or field construction personnel. Include names, company name and each person's function, telephone number and fax number.

b. The quality control organization chart shall include a Program Administrator who shall ensure that all QA procedures are followed and enforced and who shall have a minimum of 5 years experience on projects of size and scope comparable to the Work of the Contract. The Program Administrator shall be a full-time employee of the Contractor or a consultant engaged by the Contractor. Additional qualifications shall include at least one of the following:

(1) Professional Engineer, Engineer-In-Training, Bachelor of Science in Civil Engineering, Civil Engineering Technology or five years experience with airport and/or highway concrete construction.

(2) Completed New Jersey ACI Chapter's "Concrete Construction Technology" course with 5 years of airport and/or highway concrete construction experience.

(3) Qualified as ACI Concrete Transportation Construction Inspector or possessing Concrete Construction Special Inspector certification with 5 years of airport and/or highway concrete construction experience.

2. Intended project progress schedule for each mix and application, including quantities and a submittal schedule.

3. Quality Control Testing Plan, including a list of testing standards and the frequency at which each test is to be performed.

a. Include gradation and moisture content testing for fine and coarse aggregates in accordance with ASTM C136 and ASTM C566, respectively. Perform both tests (1) prior to production, (2) every 3 hours during production or every 100 cubic yards of concrete produced (whichever is longer in time) and (3) when aggregates are used from a new stockpile that has not been tested for gradation or moisture content.

4. For mass concrete as defined herein, the contractor shall submit for approval a Thermal Control Plan for each concrete mix design, and at a minimum shall include:

a. Concrete mixture proportions;

b. Calculated or measured adiabatic temperature rise of concrete;

c. Upper limit of concrete temperature at time of placement;

d. Description of specific measures and equipment that will be used to ensure maximum temperature in placement will not exceed specified maximum temperature limits;

e. Calculated maximum temperature in placement based on expected conditions at time of placement and use of proposed measures to control temperatures;

f. Description of specific measures and equipment that will be used to ensure temperature difference will not exceed specified temperature difference limit;

g. Calculated maximum temperature difference in placement based on expected conditions at time of placement and use of proposed measures to control temperature differences;

h. Description of equipment and procedures that will be used to monitor and log temperatures and temperature differences;

i. Drawing showing locations for temperature sensors in placement;

j. Description of format and frequency of providing temperature data to Engineer

k. Description of measures to address and reduce excessive temperatures and temperature differences, if they occur;

l. Description of curing procedures, including materials and methods, and curing duration; and

m. Description of formwork removal procedures to ensure temperature difference at temporarily exposed surface will not exceed temperature difference limit, and how curing will be maintained.

n. Optional methods to achieve specified special properties are but not limited to:

(1) Cool aggregates

(2) Pre-cool concrete by using chilled water, shaved or chipped ice, liquid nitrogen (LN2) in order to start with a lower concrete temperature after batching, as long as the concrete temperature is within ACI guidelines.

(3) Insulate formwork and/or curing concrete

(4) Cool concrete after placement with cooling pipes

(5) Use smaller placements

5. Documentation of Quality Control activities, including the location where recorded test results and other information such as mill test certificates for all cementitious material will be stored, which shall be made available to the Engineer at any time upon request.

6. Procedures for corrective action when QA and/or QC test results do not conform to the requirements of the Contract.

1.05 TRIAL BATCHING AND TEST POUR VERIFICATIONS

A. Trial Batching

1. The Engineer may prepare and test trial batches as specified herein and in accordance with ACI 318, Section 5.3. At the Engineer's request, submit representative samples of all materials in sufficient quantities to the Port Authority Materials Engineering Unit. In the event of a conflict between tests performed by the Engineer and tests performed by or for the Contractor, all tests performed by the Engineer shall control.

2. The Engineer may perform the following tests to verify trial batches submitted by the Contractor: compressive strength, flexural strength, permeability by the Coulomb test, air content, unit weight, water content of freshly mixed concrete using the microwave oven drying test, shrinkage, chloride ion concentration, corrosion inhibitor concentration, bond strength, slump, time of set, gradation of fine and coarse aggregates, and the fineness modulus of the fine aggregate.

B. Test Pours

1. Unless otherwise noted on the Contract Drawings, perform a test pour a minimum of 14 calendar days prior to production pouring in order to demonstrate and verify proper workability, finishability, setting characteristics, consolidation and curing procedures and to confirm that specified physical properties are attained for the approved mix proportions. For tremie concrete applications, construct a mock-up to verify acceptable consolidation and that the specified compressive strength is achieved by testing three in-place cores taken from the test placement at locations designated by the Engineer. In addition, for architectural cast in place concrete, construct a full-scale mock-up in accordance with 2.03 C.3. If in the sole opinion of the Engineer the test pour is acceptable, follow the procedures established during the test pour during production.

2. Test Pour Size: For flatwork, the minimum test pour size shall be a length of 100 feet for the entire thickness of the pavement and width of the screed planned to be used. For all other concrete construction, the test pour size shall be full-size for the cross sectional area, including the location of all steel reinforcement. However, at the option of the Engineer, the length of the member may be reduced from its design size, provided it is adequate to demonstrate workability, finishability, setting characteristics, consolidation, finish and curing procedures, as determined solely by the Engineer. Perform all test pours using the same personnel, equipment, procedures and materials that will be used for full production.

   a. Pumping of LWC: The new arch deck slab will be constructed of lightweight concrete. Should the Contractor elect to pump the lightweight concrete, perform a test pour prior to the actual construction. Submit the details of the lightweight concrete test pour to the Engineer for approval. Base the test on the height and length of the proposed pumped delivery. The pumping test pour is in addition to the requirements of Subsection 1.05.B.1 and .2.

3. The test section will be considered acceptable if, in the sole opinion of the Engineer, it meets the specifications for surface preparation, batching, mixing, placement, consolidation, curing, finish and applicable performance properties of the concrete. In addition, for architectural concrete, color and texture will be considered acceptable according to the sole opinion of the Engineer.

4. In the event that the Engineer deems the test section unsatisfactory, remove the test section and repeat the test at no cost to the Authority.

5. The test pour location will be determined by the Engineer at the pre-concrete construction meeting, and will be located close to, if not within, the area of Work, unless otherwise noted on the Contract Drawings.

1.06 PRE-CONCRETE CONSTRUCTION MEETING

A. A pre concrete placement meeting will be conducted at the construction site by the Engineer a minimum of 20 days prior to the first pour to review the Contractor's submitted mix proportions, hot and cold weather concreting plans (as applicable), curing procedures plan and test pour and to discuss the methods and procedures to achieve the specified concrete quality. For lightweight concrete, review sampling and testing procedures, placement and consolidation. Notify the Engineer and send a pre-concrete meeting agenda to all attendees a minimum of 15 days prior to the scheduled date of the meeting indicating review subjects. At no additional cost to the Authority make arrangements for the Contractor's superintendent and a qualified representative from each segment of the concrete operations to be present, including, but not limited to the following:

1. Concrete supplier.
2. Laboratory representative responsible for the concrete proportion mix and Quality Control.
3. Contractor's Program Administrator for Quality Control.
4. Concrete subcontractor.
5. Admixtures and curing membrane suppliers.
6. Concrete pumping subcontractor.
7. Mobile mixer subcontractor.
8. Precast concrete fabricator and installer.

9. Joint sawing subcontractor.
10. The Engineer.

B. Record, type, and print meeting minutes and distribute them to all attendees of the meeting within 5 days of the date of the meeting.

C. Do not schedule the pre-concrete construction meeting until all of the following have been submitted and approved, as applicable to the Work of the Contract:

1. Mix Proportions.
2. Admixture dosage charts showing the effects of concrete temperatures from 50 deg F to 90 deg F.
3. Sample panels (12" x 12" x 2" for architectural concrete).
4. Hot and Cold Weather Concrete Construction Plans.
5. Independent testing laboratory AASHTO Accreditation Certification.
6. ACI Grade I certifications for concrete testing personnel.
7. Placement methods and procedures, including surface preparation.
8. Pumping Procedure Plan.
9. Curing Procedure Plan.
10. Joint Location Plan and Timing of Cuts.
11. Quality Control Plan.
12. Procedure for Curing Field Concrete Specimens.

1.07 SUBMITTALS

A. See Appendix "A" for submittal requirements.

B. Do not deliver any concrete to the construction site until all approvals have been obtained.

PART 2. PRODUCTS

2.01 MANUFACTURERS AND SOURCES OF SUPPLY

A. Use no cement, fly ash, slag, silica fume, metakaolin or fine or coarse aggregates that have not been approved by either the New Jersey or New York State Department of Transportation. For suppliers without current approval of either state, approval may be obtained prior to the actual first use of the product or material.

2.02 MATERIALS

A. Cement: Conforming to ASTM C150, Type I and II, and Type III where early strength gain is required, or others specified on the Contract Drawings.

B. Very High Early Strength Cement: Defined as cement used to produce concrete with the compressive strength shown on the Contract Drawings within 12 hours or less and conforming to the following:

1. The compressive strength shall be greater than or equal to the specified strength at the curing time specified on the Contract Drawings, when tested in accordance with ASTM C39. During cold weather concrete construction, demonstrate that the specified compressive strength can be obtained at a curing temperature of 50 deg F.

2. Absolute drying shrinkage less than or equal to 0.03% at 28 days for the mix proportions containing the Very High Early Strength Cement in accordance with ASTM C157 modified (Air Drying Method), where the initial reading shall be taken at 3 hours after the addition of the mixing water to the dry materials in the mix.

3. Setting time, determined in accordance with ASTM C191, shall be sufficient to provide adequate workability, meet the specified strength requirement, and allow enough time in the field to finish and begin curing the concrete for its intended use.

4. The Very High Early Strength Cement shall meet the properties in 2.02 B.1, 2.02 B.2 and 2.02 B.3, for each Lot of cement not to exceed every 50,000 pounds. Submit certification from an independent testing laboratory employed by the Contractor and approved by the Engineer that the cement meets these properties.

C. Silica Fume: Shall conform to ASTM C 1240 and the following:

1. Silicon Dioxide Content: 90% minimum.
2. Loss On Ignition: 6% maximum.
3. Surface Area: (nitrogen absorption): 15,000 m2kg.
4. Crystallinity: Non-crystalline within limits of detection by XRD.
5. Oversize Foreign Materials (in fume): 5% maximum on 45-micron sieve (wet).

D. Metakaolin: Conforming to ASTM C618, Class N. Use one of the following products, or approved equal:

1. "MetaMax", as manufactured by BASF, Florham Park, New Jersey.
2. "PowerPozz", as manufactured by Advanced Cement Technologies, LLC, Blaine, Washington.

E. Fly Ash: Conforming to ASTM C311 and ASTM C618, Class F except the maximum loss on ignition shall be less than 4%.

F. Slag: Conforming to ASTM C989, Grade 100 or 120.

G. Fine Aggregate: Conforming to ASTM C33, ASTM C227, ASTM C289 and ASTM C131 with a maximum percentage of wear of 30%.

H. Coarse Aggregate (Normal Weight Concrete): Conforming to ASTM C33, ASTM C227, ASTM C289, ASTM C535 with a maximum percentage of wear of 40%, and ASTM C88 with a magnesium sulfate loss of not more than 12% for a five-cycle test period. Use trap rock or gneiss for all pavement wearing surfaces. The aggregate in any size group shall not contain more than 8% by weight of flat or elongated pieces, as tested in accordance with ASTM D 4791. A flat or elongated piece is one having a ratio between the maximum and minimum dimensions of a circumscribing rectangular prism exceeding 5 to 1. In accordance with ACI 318, Section 3.3.2, the nominal maximum size of coarse aggregate shall be not larger than: (1) one-fifth the narrowest dimension between sides of forms, (2) one-third the depth of slabs, or (3) three-quarters the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts. The nominal maximum size of coarse aggregate used shall be the largest size aggregate that conforms to ACI 318, Section 3.3.2, unless otherwise noted herein. All structural and pavement slab concrete shall be designed with 467 aggregate.

1. For full depth pavement concrete the combined aggregate volume shall be a minimum of 70 percent. The combined gradation of the fine and coarse aggregate shall conform to the following, when tested in accordance with ASTM C136:

	For Pavement 10 Inches	For Pavement Less Than

	or Greater in Thickness		10 Inches in Thickness	
Sieve Size % Passing	Min.	Max.	Min.	Max.
2-1/2"	100			
2"	90	98	100	
1-1/2"	76	88	89	98
1"	67	79	74	86
3/4"	65	77	64	76
3/8"	48	60	48	60
No. 4	30	42	30	42
No. 8	27	37	27	37
No. 16	20	30	20	30
No. 30	16	22	16	22
No. 50	4	10	4	10
No. 100	0	4	0	4

2. Pile Jackets: As a minimum, the mix proportion shall contain an ASTM C33 Size No. 8 coarse aggregate. The ratio of coarse aggregate to fine aggregate by volume shall be not less than one to one.

3. Pipe Piles: Reduce the amount of coarse aggregate to minimize segregation. The volume of coarse aggregate shall not exceed 9.0 cubic feet per cubic yard of concrete. The maximum size coarse aggregate shall be ASTM C33 Size No. 8.

4. Minimum Volume of Coarse Aggregate: All mixes shall contain a minimum of 39% coarse aggregate by volume, with the exception of:

   a. applications specified in Part 2.02 H.1-4,

   b. Performance Category VI applications,

   c. bridge decks, and

   d. mixes containing ASTM C33 Size No. 8 aggregate.

   Bridge deck concrete mixes shall contain a minimum of 41% coarse aggregate and total minimum aggregate volume of 67%. Mixes containing ASTM C33 Size No. 8 stone not covered in 2.02 H.2-4 shall contain a minimum of 36% coarse aggregate by volume. These minimum requirements apply to all methods of placement, including pump mixes.

   Lightweight concrete mixtures shall be proportioned to meet density and workability requirements.

5. When requested by the Engineer, supply independent laboratory test results in accordance with ASTM C1260 indicating the potential alkali reactivity of the aggregates and cementitious materials proposed for use. Expansion at 16 days shall be less than 0.10%.

I. Coarse Aggregate (Lightweight Concrete)

1. Expanded clay, shale or slate produced by the rotary kiln process conforming to ASTM C330 shall be graded in accordance with the requirements for 3/4" to No. 4 sieve sizes shown in Table I of that specification. Optionally, a 1/2" to No. 4 gradation may be used for improved pumpability.

a. Grade coarse aggregate for lightweight concrete fill for the grating of the Shared Use Path on the arch structure in accordance with the requirements of 3/8" to No. 8 sieve sizes.

2. The oven dry unit weight of plant-tested, lightweight aggregate shall vary not more than +/- 3.0 pounds from the unit weight (pounds per cubic foot) determined from the sample quantity submitted in accordance with 1.05 A.1.

J. Water: Conforming to AASHTO T 26. Clean and potable for both mixing and curing concrete.

K. Formulated Latex Modifier: Latex modifier shall be modifier "A/NA", as manufactured by Dow Chemical, Midland, Michigan. Add latex emulsion at a rate of 3.5 gallons per 94 lbs. of cementitious material in the concrete mix.

L. Air Entraining Agent: Conforming to ASTM C260.

M. Admixtures: All admixtures shall conform to ASTM C494. They shall contain not more than 0.05% chloride ions, and shall be used in accordance with the manufacturer's recommendations. Submit dosage charts, including the effects of concrete temperatures from 50 deg F to 90 deg F, to the Engineer. All admixtures shall be manufactured by one of the following:

1. Euclid Chemical Company.
2. W.R. Grace & Company.
3. The BASF Group.
4. Sika Corporation.

N. Polycarboxylate High Range Water Reducer: For use when self-consolidating concrete is desired and approved by the Engineer. Conforming to ASTM C494, Type F or Type G. Dosage rate shall be as recommended by the manufacturer to produce a spread of the concrete mixture measuring between 21 and 27 inches in diameter without segregation when released from a slump cone in accordance with ASTM C1611. Use one of the following products, no substitutions:

1. "Plastol 5000" or "Plastol 341", as manufactured by The Euclid Chemical Company.
2. "ADVA Flow 530" or "ADVA Flow 540", as manufactured by W.R. Grace & Company.
3. "Glenium 3030 NS" or "Glenium 3200 HES", as manufactured by The BASF Group.

O. Corrosion Inhibitors

1. Corrosion inhibitor shall be one of the following:

a. For cast in place or precast:

(1) "DCI-S", as manufactured by W.R. Grace & Company.

(2) "Eucon CIA", as manufactured by Euclid Chemical Company.

(3) An approved equal.

b. For precast applications only:

(1) "Sika CNI", as manufactured by Sika Corporation.

(2) "Rheocrete CNI", as manufactured by The BASF Group.

(3) "DCI", as manufactured by W.R. Grace & Company.

2. The concentration of calcium nitrite shall be 30% +/- 2% by weight of solids per gallon.

3. The Engineer will sample the corrosion inhibitor for testing to verify the calcium nitrite solids content. The amount of calcium nitrite in fresh concrete may also be tested at any time, to verify if the proper quantity of the corrosion inhibitor is being batched in the mix.

4. Corrosion inhibitor admixtures shall not accelerate the setting time of the concrete mixture. Use a retarder and/or other admixtures to ensure that acceleration of setting time does not occur, while maintaining the applicable performance criteria, as stipulated in 2.04. Submit procedures for the placement of concrete mixes containing a corrosion inhibitor when a retarder is required for the range of concrete temperatures from 50 deg F to 90 deg F.

P. Viscosity Modifying and/or Self-Consolidating Admixtures: May be required for tremie concrete applications at the rate recommended by the manufacturer. Test concrete in accordance with CRD-C6189A US Army Corps of Engineers "Handbook of Concrete and Cement". Maximum percentage of washout weight loss shall not exceed 5% after three standard test drops in water.

Q. Pigments: Conforming to ASTM C979.

R. Curing Materials

1. Curing compound shall be one of the following:
   a. "DOT Resin Cure (Type II)", as manufactured by Conspec Marketing & Manufacturing Company, Inc.
   b. "Euco Kurez Vox (White)", as manufactured by Euclid Chemical Company.
   c. "1200 White", as manufactured by W.R. Meadows.
   d. "AHT Type II Class B Cure", as manufactured by American Highway Technology, a Dayton Superior Company.
   e. "Certi-Vex Envio Cure White-1000", as manufactured by Vexcon Chemicals Inc.
   f. "Day-Chem White Pigmented Cure (J-10-W)", as manufactured by Dayton Superior.
   g. Or an approved equal meeting the requirements specified in 2.02 R.2.
2. Liquid Membrane Forming Curing Compound conforming to the following:
   a. For horizontal exterior applications, curing membranes are restricted to ASTM C309 Type 2, Class B materials. ASTM C309 Type 1-D, Class B membranes are acceptable for other exterior applications. ASTM C309 Type 1, Class B membranes are acceptable for interior applications only.
   b. Curing membranes shall be wax free when used on concrete where overlays, coatings, paints, sealers or any topping is to be applied, or where vehicular, pedestrian or aircraft traffic will pass over.
   c. Membranes shall be volatile organic compound (VOC) compliant for the states of both New York and New Jersey. Submit certification of compliance to the Engineer upon request.
   d. The membrane shall restrict the loss of water to not more than 0.40 kilograms per square meter in 72 hours at a coverage rate of 300 square feet per gallon per coat for Type I curing compounds, and 200 square feet per gallon per coat for Type 2 curing compounds when tested in accordance with ASTM C156.
3. Burlap: Conforming to AASHTO M 182, Class 3, weighing approximately 9 oz./sq. yd. dry.

4. Sheet Material: Conforming to ASTM C171.
   a. Shall be White Burlap Polyethylene Sheet.
5. Cotton Mats: conforming to ASTM D 5199 with a minimum thickness of 40 mils, ASTM C156 with a maximum water loss of 0.0065 oz./in.^{2}, ASTM D 4833 with a minimum puncture strength of 70 pounds and ASTM E 1347 with a minimum reflectance of 75%. The following cotton mats may be used in lieu of burlap for wet curing operations:
   a. "Transguard 4000", as manufactured by Reef Industries, Inc., Houston, Texas, or
   b. An approved equal conforming to the requirements specified in 2.02 R.5.

S. Evaporation Retardant: This material shall be used to retain moisture in the concrete during finishing operations. Use one of the following:
1. "Euco-Bar", as manufactured by Euclid Chemical Company.
2. "E-Con", as manufactured by L&M Construction Chemicals, Inc.
3. "Confilm", as manufactured by The BASF Group.
4. "SikaFilm", as manufactured by Sika Corporation.
5. "Aquafilm", as manufactured by Conspec Marketing & Manufacturing Company, Inc.

T. Fiber Reinforcement:
1. Polypropylene Micro Fibers
   a. Use one of the following products, subject to compliance with the Contract requirements:
      (1) "Fiberstrand", as manufactured by Euclid Chemical Company.
      (2) "Fibermesh", as manufactured by Fibermesh, Inc.
      (3) "Forta", as manufactured by Forta Corporation.
      (4) "Grace Fibers" or "Grace Microfibers", as manufactured by W.R. Grace & Company.
      (5) "Durafiber", as manufactured by Industrial Systems, Ltd.
      (6) Or an approved equal.
   b. Additional requirements:
      (1) Collated fibrillated materials: Dosage rate shall be a minimum of 1.5 lb./cu. yd.
      (2) Multifilament fibers: Dosage rate shall be a minimum of 1 lb./cu. yd. The minimum length shall be 0.75 inches.
      (3) Conformance with ASTM C1116, designation Type III, 4.1.3.
      (4) Conformance with a minimum plastic shrinkage crack reduction of 70 percent when tested in accordance with ICBO ES, Appendix B (7-92).
      (5) Use of fibers shall not change the water requirements of the mix.
      (6) Conform to the manufacturer's recommendations for the quantity of fiber, which shall be not less than the minimum requirements of 2.02 T.1.b.1 and 2.02 T.1.b.2.
      (7) Arrange for the fiber manufacturer to provide the services of a qualified representative at the pre-concrete construction meeting and for the first two days of fibrous concrete placement production.

2. Structural Polypropylene/Polyethylene Macro Fibers

a. Use one of the following products, subject to compliance with the Contract requirements:

(1) "Tuf-Strand SF", as manufactured by Euclid Chemical Company.

(2) "Strux 90/40", as manufactured by W.R. Grace & Company.

(3) Or approved equal.

b. Additional requirements:

(1) Dosage rate shall be a minimum of 4.0 lb./cu. yd. Higher dosages may be noted on Contract Drawings.

(2) The minimum length shall be 1.50 inches.

(3) Fiber shall have an Aspect Ratio of 50 to 90.

(4) Conformance with ASTM C1116, designation Type III, 4.1.3.

(5) The structural macro fiber concrete shall have an average residual strength of 200 psi when tested in accordance with ASTM C 1399.

(6) Use of fibers shall not change the water requirements of the mix.

(7) Conform to the manufacturer's recommendations for the quantity of fiber, which shall be not less than the minimum requirements of 2.02 T.2.b.1.

(8) Arrange for the fiber manufacturer to provide the services of a qualified representative at the pre-concrete construction meeting and for the first two days of fibrous concrete placement production.

U. Expansion Joints (Except for Bridge Decks) and Contraction Joints (Except for Aeronautical Pavements)

1. Vinyl plastic water stops shall be of types and sizes shown on the Contract Drawings and conforming to Corps of Engineers "Specifications for Polyvinylchloride Waterstop" (Designation: CRD-C 572-60, latest revision).

2. Premoulded expansion joint filler, when shown on the Contract Drawings:

a. Cork type shall be ASTM D1752, Type II.

b. Bituminous type shall be ASTM D1751.

3. Joint Sealant when shown on Contract Drawings: Federal Specification SS-S-1401, latest revision.

V. Mass Concrete is defined as any placement of structural concrete that has a minimum dimension equal to or greater than 30 inches.

1. Unless otherwise specified on the contract drawings, use hydraulic cement with moderate to low heat of hydration properties or use a Portland cement with Class F fly ash or slag cement, or both

2. Unless otherwise specified on the contract drawings, do not use ASTM C150 Type III cement or ASTM C1157 HE cement.

3. Unless otherwise specified on the contract drawings, do not use accelerating admixtures

2.03 MIX PROPORTIONS

A. Develop mixes in accordance with the latest editions of ACI 211, ACI 301 and ACI 318 to achieve the proportion performance criteria in accordance with the Contract Documents, with a degree of excess as determined by Chapter 5 of ACI 318, and meet all of the applicable performance criteria as specified in the Contract Documents. In addition, all concrete placed underwater shall conform to ACI 304R, Chapter 8, mass concrete shall conform to ACI 207, and lightweight aggregate concrete shall conform to ACI 213. Submit an underwater concrete placement procedure that is in conformance with ACI 304R, Chapter 8. Prior to concrete construction and after approval of all materials to be used in the concrete, submit a mix proportion showing that all performance criteria have been met. Mix proportions submitted shall be based upon laboratory trial mix test results and/or mixes successfully used within the two years preceding the date of the submittal of the mix for the Work of this Section.

The independent testing laboratory used to develop the mix proportions and to perform testing shall have AMRL and CCRL Accreditation for all test methods required to be performed and to develop the required mix. Submit proof of certification to the Engineer prior to the start of development of the mix proportions and testing. The mix proportions shall include copies of test reports, including test dates, and a complete list of materials, including type, brand and source. The trial mix design performed in the testing laboratory shall use the same materials, cement, pozzolans, aggregates and admixtures that will be used at the proposed batch plant. Show fineness modulus, gradations and absorptions of aggregates. If any of the approved mix constituents change in source, properties or proportion, submit a new mix. The mix proportions shall also conform to the following:

1. Substitute either fly ash or slag at the minimum rate of 20% by weight of cement. The maximum rates of substitution shall be 30% for fly ash and 70% for slag, unless otherwise approved by the Engineer. Fly ash and slag substitution in the same mix may be permitted upon approval by the Engineer. Bridge decks require a minimum of 30% fly ash only, no slag permitted.
2. For concrete placed underwater, the minimum cementitious material content shall be 700 pounds per cubic yard of concrete.
3. Compute water to cement ratio using the weight of cementitious material that is equal to the total weight of cement plus fly ash, slag and silica fume. Any admixtures which increase the water to cement ratio by 0.01 or greater shall be accounted for in the mix proportion to meet the specified water to cement ratio. For drilled shafts, the water to cement ratio (W/C) shall be 0.40, +/- 0.05 after including any reductions for admixtures.
4. For Categories II, III and IV concrete applications, the mix water to cement ratio shall not exceed 0.40 and the absolute drying shrinkage at 28 days shall not exceed 0.03% in accordance with ASTM C157 (Air Drying Method), modified to start measuring at 10 hours. In addition for Categories III and IV, the maximum Coulomb count at 28 days shall be 1,000 for mixes. For mixes that do not have silica fume, latex or metakaolin but contain either fly ash or slag, the Coulomb count requirements shall remain the same; however, the test shall be conducted according to the accelerated method (7 days normal cure, 21 days wet cure at 100°F) and values taken at 28 days.

For concrete pavements and Categories I and V applications where the concrete will be exposed to freeze-thaw cycles and/or sulfates, the mix proportion water to cement ratio shall not exceed 0.40 and the absolute drying shrinkage at 28 days shall not exceed 0.03% in accordance with ASTM C157 (Air Drying Method) modified to start measuring at 24 hours. For other concrete applications, the mix water to cement ratio shall not exceed 0.50, unless otherwise shown on the Contract Drawings.

5. High Range Water Reducer shall not be added to the concrete mix at the plant. It shall be delivered to the construction site in a tank fixed to the truck that discharges directly into the mixing drum, or it may be added to the drum from a calibrated dispensing unit. A calibrated dispensing unit shall be defined as a manufactured dispenser with clear volume indications marked on the outside of the unit. It shall be available at all times during the concrete placement for re-dosing purposes. Submit a re-dosing chart showing the dosages necessary to increase the slump, in inches per cubic yard of concrete remaining in the drum, over the range of concrete temperatures from 50 deg F to 90 deg F. If re-dosing occurs, the re-dosing chart shall be used, but under no circumstances shall the total dosage exceed the maximum dosage recommended by the manufacturer. The truck shall mix the load for a minimum of an additional 5 minutes prior to releasing the load.

6. The percentage of air in the mix shall fall within the range of the Lower Quality Limit (LQL) and the Upper Quality Limit (UQL) as outlined in the table shown in 2.04 A.6 entitled "Air Content Target Range for Freshly Mixed Concrete". Air content shall be determined by testing in accordance with ASTM C231 for normal and heavyweight concrete mixes and ASTM C173 for lightweight aggregate.

7. Make adjustments to the weight of coarse, lightweight aggregate in accordance with the following:

   a. Design lightweight concrete mix proportions such that the equilibrium unit weight does not to exceed 120 pounds per cubic foot, unless otherwise specified.

   b. Adjust the proportion of lightweight aggregate to compensate for the difference between the wet unit weight determined in 3.05 B.5 and the dry unit weight of the material submitted in accordance with 1.05 A.1 and the approved mix proportions.

   c. Lightweight aggregates must be saturated for a minimum of 72 hours prior to mixing of concrete. The optimum aggregate saturation level will be determined by the Engineer from submitted samples prior to the start of concrete placement. Aggregates will be tested at the plant 48 hours prior to batching to determine percent saturation of the aggregates. Any aggregates with a percent saturation less than 95% of the optimum saturation level will be rejected until continued wetting brings the aggregate to the required saturation.

   d. For drilled shafts, proportion the aggregates so that fine aggregate is less than 50 percent by weight of the total aggregate.

8. Mass concrete as defined herein shall be designed according to ACI 207, ACI 224, ACI 305 and ACI 306 and at a minimum meet the following:

   a. Produce a mix design that results in a structure free from cracks due to heat of hydration during the curing of large concrete cross section. Optional methods to achieve specified special properties can include but are not limited to:

      (1) Minimize cementitious materials

      (2) Use cement type II

      (3) Use fly ash type F and slag

(4) Use aggregates with low coefficient of thermal expansion

(5) Use larger aggregates

(6) Minimize water-cement ratio

B. Where Latex Modified Concrete is specified in the Contract Documents, conform to ACI 548.4. The mix maximum water to cement ratio shall not exceed 0.37. The minimum volume of coarse aggregate shall be not less than 7.6 cubic feet (absolute volume) per cubic yard.

C. Architectural Concrete

Concrete that will be permanently exposed to view and which therefore requires special care in selection of concrete ingredients including color, forming, placing, consolidating and finishing to obtain the desired architectural appearance is designated as "Architectural Concrete".

1. A minimum of 35 days prior to construction of a mock-up, submit mix proportions and two sample panels (a minimum of 12" x 12" x 2") for each mix to the Engineer for approval. The materials used for the sample panels shall be from the same sources of material supply for all constituents in the approved mix. When requested by the Engineer, submit samples of all constituents for trial batching to the Port Authority Materials Engineering Unit to verify that the physical property requirements are met. Obtain approval for both sample panels for color and texture, as well as for the mix proportions for physical properties prior to constructing a mock-up.

2. Pigments, in conformance with ASTM C979, shall be used when matching the color of existing concrete or when a specific color of concrete is required by the Engineer.

3. Construct mock-up only after the Engineer has approved both the mix proportions for physical properties and the sample panels for color and texture. For cast in place concrete, a mock-up in accordance with ACI 303.1 Section 1.6 Quality Assurance will be required for approval by the Engineer. For walls, a mock-up shall include all details that will be encountered in a typical day's pour. The mock-up may be constructed at the construction site as part of the permanent Work at the sole risk of the Contractor. If the Engineer rejects the mock-up, it shall be removed and recast at the sole expense of the Contractor. For precast architectural concrete, the mock-up shall consist of a full member selected in advance by the Engineer. Keep the approved mock-up at the precast concrete production facility for the Engineer to compare with the production units for acceptance or rejection. Acceptance or rejection shall be determined solely by the Engineer.

4. Construct mock-ups only with all of the actual constituents of the approved mix proportions. Do not proceed with production until the mix proportions, sample panels, full-scale mock-up and shop drawings have been approved by the Engineer. Once production begins, do not change suppliers or sources of supply for any of the constituents in the approved mix for the duration of the Contract.

5. In addition to the mix proportions and sample panels, submit the following for approval: forms, form liners and form oil or release agents.

6. Architectural Concrete shall conform to the Quality Assurance performance criteria specified in 4.01 B, Table 2 for the appropriate placement application and the associated Quality Acceptance Limits specified in 2.04.

7. Noticeable differences in color and/or texture of the finished product, as determined solely by the Engineer, shall be corrected by means and materials approved by the Engineer.

D. Pipe Piles: The target range for slump shall be 4 to 6 inches.

2.04 QUALITY ACCEPTANCE LIMITS

A. Develop mixes to meet the following performance criteria Quality Acceptance Limits in accordance with the relevant application properties specified in 4.01.B., Table 2, unless otherwise noted on the Contract Drawings:

1. Compressive Strength (ASTM C39): The Lower Quality Limit, LQL, shall be the specified mix compressive strength at 56 days, unless when high early strength is required or otherwise noted on the Contract Drawings.
2. Flexural Strength (ASTM C78): The Lower Quality Limit, LQL, shall be 700 psi at 28 days, unless otherwise noted on the Contract Drawings.
   a. Splitting Tensile Strength (ASTM C496): For lightweight concrete only, the Lower Quality Limit shall be 520 psi at 28 days, unless otherwise noted on the Contract Drawings.
3. Permeability (AASHTO T 277): The Upper Quality Limit, UQL, shall be 1000 Coulombs. Performance testing shall be performed at 28 days, except for mixes containing only fly ash and/or slag substitution for cement but no silica fume or metakaolin, which shall be evaluated at 28 days using the accelerated method.
4. Bond Strength (ASTM C1583): The Lower Quality Limit, LQL, shall be 150 psi at 28 days.
5. Water Content (AASHTO T 318): The Upper Quality Limit, UQL, for water content shall be the specified water to cementitious ratio specified in 2.03 A.4 plus 0.05.
6. Air Content (ASTM C138, ASTM C173 or ASTM C231): Both the Lower Quality Limit, LQL, and the Upper Quality Limit, UQL, shall be as specified in the table below:

AIR CONTENT TARGET RANGE FOR FRESHLY MIXED CONCRETE

MAXIMUM SIZE AGGREGATE (SIZE #)	AIR CONTENT LQL	AIR CONTENT UQL
2" or above (# 467 and above)	3.5%	7.5%
1-1/2" (# 57)	4.0%	8.0%
1" (# 67)	4.5%	8.5%
1/2" (# 8)	5.5%	9.5%
3/8"	6.0%	10.0%
Latex modified concrete	2.5%	6.5%

Note: For a specified compressive strength greater than 5000 psi, the LQL and UQL for air content, as indicated above, shall both be reduced by 1.0%. For all concrete applications not exposed to freeze-thaw cycling or chlorides, no air entrainment is required.

7. Chloride Ion Concentration by Weight of Cementitious Material (ASTM C1152, ASTM C1218, ASTM C114, ACI 222R): The acid soluble chloride ions by weight of cementitious material in the concrete mix shall be less than or equal to 0.10% for reinforced concrete and 0.08% for prestressed concrete, as per ACI 222R. The water soluble chloride ions by weight of cementitious material in the concrete mix shall be less than or equal to 0.08% for reinforced concrete and 0.06% for prestressed concrete, as per ACI 222R.

8. Pavement Thickness: The Lower Quality Limit, LQL, for pavement thickness shall be 97.0% of the thickness shown on the Contract Drawings.

9. Delaminations of overlays: The total surface area tested for any given Lot of concrete shall indicate less than 5.00% delaminated area when tested using the chain drag in accordance with ASTM D 4580.

10. Cracking: For decks and girders, crack widths shall not exceed 0.008 inches, and the total length of cracks per a 100 square-foot area within joint boundaries shall not exceed 10 linear feet as determined by the Engineer. All other structural members, including precast members at the plant or in the field, and any mass concrete members shall be free from cracks.

11. Lightweight Concrete Density: The Lower Quality Limit, LQL, for lightweight concrete density shall be 116 pcf.

B. For concrete bridge decks where riding surface tolerances are required, as shown on the Contract Drawings, refer to the specification Section 02510.

C. Mass concrete as defined in ACI 207 or as specified on Contract Drawings shall have the following unique properties:

1. The temperature at the core of the in situ concrete shall not exceed 158 deg F

2. The maximum difference in temperature between the core and the surface of the structure shall not exceed 35 deg F at any time.

3. The drop in temperature in the first 24 hours after the end of protection shall not exceed the limits of ACI 306R Table 3.1.

D. Unless otherwise specified on the Contract Drawings, the above specified Quality Acceptance Limits will be used to calculate Adjustments to Contract Compensation in accordance with Part 4 of this Section.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. Bonded Overlays and Patching Applications

1. Bond strength tests will be performed by the Engineer in accordance with ASTM C1583, using 4-inch by 4-inch steel plates, to determine the adequacy of the surface preparation. A minimum average bond strength of 200 psi shall be attained, with no single test value less than 180 psi. If time does not permit the above test to be performed, as determined solely by the Engineer, the Engineer will measure the macrotexture depth in accordance with ASTM E 965. A minimum of four tests will be performed and the average macrotexture depth shall be a minimum of 0.06 inches. Prior to the placement of any overlay or patching material, obtain the Engineer's approval of the surface preparation.

B. Latex Modified Concrete and Silica Fume Concrete

1. The Engineer will sound the concrete surface to identify areas of unsound or deteriorated concrete. Areas so identified shall be removed to the limits and depths as ordered by the Engineer. Perform abrasive blasting of all exposed reinforcing steel that is to remain in place.

C. Construction Joints (excluding joints in pavements)

1. Number, locations and details shall be as shown on the approved shop drawings.
2. Planes of joints shall be normal to direction of pressure and shall include suitable keys and dowels.
3. Locate joints at points of minimum shear, unless otherwise shown on approved shop drawings or directed by the Engineer.
4. Avoid lips and other irregularities between adjoining sections of concrete. Secure forms tightly against previously placed concrete.

D. Expansion and Contraction Joints (excluding joints in pavements)

1. After curing concrete, clean grooves or saw cuts to receive joint sealant by scrubbing with a mechanical wire brush to loosen dirt and other foreign matter and blowing out loose matter with compressed air.
2. Install joint sealant to finish flush with concrete surface, except where otherwise shown on the Contract Drawings.

E. Preparation for Placing Concrete (excluding pavements)

1. Straighten bent dowels, whether placed under this Contract or by others, using tools approved by the Engineer. Do not apply heat to dowels.
2. Clean all dowels and all steel that will be embedded in concrete, of all loose rust, scale, paint, grease and other objectionable materials.
3. Examine coated reinforcement for integrity of coating. Repair all damaged areas in accordance with the requirements of Specification Section 03200 entitled "Concrete Reinforcement". Make the repair crew available at the time of examination.
4. Check all formwork locking devices to ensure that they are in place and properly secured.
5. Do not place concrete for piles, footings, pile caps or slabs supported on pile caps or piles until the pile survey has been completed and additional reinforcing steel, if necessary, has been added as directed by the Engineer.
6. For preparation of surfaces to receive concrete, conform to the Contract Drawings for all procedures, equipment limitations and requirements to be performed prior to placing concrete.
7. Do not place concrete for slabs-on-grade, grade beams or footings until the subgrade has been inspected and approved by the Engineer, and until any base course or fill has been properly compacted in accordance with the Contract requirements.
8. Provide vent holes (1/4 inch diameter, minimum) edge angles or embedded plates at joints where vibrating alone will not ensure elimination of voids. Locate such holes at high points and with uniform spacing along joints for escape of air during concreting operations. Evidence of voids adjacent to embedments will be cause for rejection of work. Submit all vent holes and procedures for placement of concrete at joints with the shop drawings for review and approval.
9. Make provisions for the concrete to pass through the reinforcing steel without segregating during placement.

3.02 BATCHING AND MIXING CONCRETE

A. Measurement of Proportions

1. All concrete batching shall be in conformance with ASTM C94 and ACI 304R.
2. For Very High Early Strength Concrete requiring 2000 psi or greater in 6 hours or less time, the method of batching will be restricted to a calibrated mobile mixer, or to a transit mixer that is loaded at the construction site with bulk bags of the Very High Early Strength Cement. Bulk bags shall contain sufficient Very High Early Strength Cement by weight to batch for a minimum of 3 cubic yards of concrete.

B. Mixing Concrete

1. Arrange for transit mix trucks to be inspected and approved annually by either the New Jersey or New York State Departments of Transportation.
   a. Mixers shall be equipped with a metal plate attached by the manufacturer, indicating the volume of mixed concrete the equipment is intended to produce. The quantities of materials transported and the volume of mixed concrete produced shall not exceed the mixer's rated capacity. In locations where the rate of depositing is slow, the Engineer may restrict the volume of concrete that may be mixed in a mixer to a volume less than the manufacturer's rated capacity of the mixer.
   b. Immediately repair or withdraw from use any mixer which is determined to be mechanically unsatisfactory.
2. If truck mixers are used, keep available a sufficient number to ensure continuous delivery of the concrete at the rate required for the proper handling, placing, finishing and curing of the concrete. If a plant at the construction site is used, it shall be of sufficient capacity to meet such requirements.
   a. Mixers shall be of the revolving-drum type, with drums suitably mounted and fitted with adequate blades capable of discharging the mixture without segregation. All truck mixers shall be equipped with an accurate, operable counter to measure the number of drum revolutions and an accurate, working water site gage or manometer to measure the volume of water introduced into the drum. Truck mixers without an accurately operating counter or water site gage shall be immediately withdrawn from use.
3. The Engineer may permit one re-tempering of the concrete subject to the following:
   a. When the measured water content in the batch is less than the water in the approved mix proportion.
   b. The redosage of high range water reducer shall conform to the Engineer-approved redosage chart and shall not exceed the manufacturer's recommended limitation, nor shall it retard the initial set of the concrete by more than 30 minutes.
   c. When air content is below the lower quality limit specified in 2.04 A.6.
4. The Engineer may reject concrete in the following instances:
   a. Concrete has not been placed within 90 minutes from the time the cement had first contact with water.
   b. Concrete temperature reaches 92 deg F.
   c. The mix appears to be segregated.

d. For mass concrete, discharge temperatures that do not conform to approved Thermal Control Plan.

5. The Engineer will reject concrete subject to the following:

a. Concrete that has partially hardened or has attained its initial set prior to placement.

b. The water to cement ratio as determined by AASHTO T 318 exceeds that given in 2.03 A.4 by 10%.

6. Construction Site Mixing: Measure mix components in accordance with tolerances given in ASTM C94. Weigh all non-liquid components and measure all liquid components immediately prior to batching. Use a calibrated flask with clear indication markings for ounces, pints, etc. when measuring liquid components. Measures without calibrated clear indication markings will not be permitted. Mix concrete materials in an approved drum-type batch machine mixer.

a. For a mixer capacity of 1 cubic yard or less, continue mixing a minimum of 3 minutes, but not more than 5 minutes after ingredients are in the mixer and before any portion of the batch is released.

b. For a mixer capacity of greater than 1 cubic yard, increase the mixing time by 1 minute for each additional 1 cubic yard.

c. Provide a batch ticket to the Engineer for each batch discharged and used in the Work, indicating the Contract number and title, date, time, mix type, mixing time, quantity of each constituent, volume of concrete and amount of water added. Record a location of the deposit in the structure that can be easily identified.

C. Mobile Mixers: When application requires the use of a mobile mixer, it shall meet the following criteria:

1. Proportioning and Mixing Equipment -

a. Mixer shall be a self-contained, self-propelled, continuous mixing type capable of carrying sufficient unmixed dry cement, aggregates, water and admixtures to produce not less than 6 cubic yards of concrete. Maintain a calibrated back-up unit at the construction site ready for use.

b. Mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter, visible at all times and equipped with a ticket printout, shall indicate this quantity.

c. Mixer shall provide positive control of the flow of water and admixtures. Water flow shall be indicated by flow meter and shall be readily adjustable to accommodate minor variations in aggregate moisture.

d. Mixer shall be capable of being calibrated to automatically proportion and blend all components of indicated composition on continuous or intermittent basis as required by the finishing operation, and shall discharge mixed material through a chute directly in front of the finishing machine. Notify the Engineer a minimum of 48 hours prior to calibration of the mobile mixers. Before approving the calibration of the mobile mixer, the Engineer will witness the calibration of the mobile mixer. However, the Contractor is responsible for testing the mix produced. Allow the Engineer to test the concrete mix at any time.

e. Calibrate mixer to accurately proportion the specified mix. Certification of calibration by an Engineer approved testing agency will be accepted as evidence of this accuracy, provided such certification attests the yield to be true within the following tolerances (by weight):

Coarse Aggregate	+/- 2%
Fine Aggregate	+/- 2%
Cement	+/- 1%
Water	+/- 1%
Admixtures	+/- 3%
Latex	+/- 1%

f. Mix in accordance with the specified requirements for the equipment used. The concrete, as discharged from the mixer, shall be such that finishing operations can proceed at a steady pace with final finishing completed before the formation of the plastic surface film.

g. Repair mixers not functioning in a manner the Engineer considers acceptable. If repair is not practical, remove the mobile mixer from the construction site and replace it with one which functions properly.

h. Prior to production, test the moisture content of the fine aggregate and coarse aggregate. Adjust the water gage setting only in the presence of the Engineer, to produce the approved mix water to cement ratio. Test the moisture content of the fine aggregate and coarse aggregate every 3 hours during production, or when the mobile mixer is loaded with aggregates from a stockpile different from the one for which moisture content tests were performed, whichever occurs first. Make adjustments in the presence of the Engineer. For Latex Modified Concrete, the maximum permissible moisture content of fine aggregate and coarse aggregate shall be 6.0% and 3.0%, respectively, as determined in accordance with ASTM C566. If these limits are exceeded, stop concreting operations until drier aggregates are obtained. Allow the Engineer to view and copy all records for moisture content testing at any time.

3.03 PLACEMENT FIELD REQUIREMENTS

A. During all concrete placements at the construction site, the Contractor shall have an individual in a supervisory capacity present with a valid certification from ACI Concrete Construction Special Inspector.

B. Prior to any construction site delivery of concrete, furnish, deliver and maintain insulated curing boxes of sufficient size and strength to contain all the specimens (cylinders and beams) made by the Engineer in any two (2) consecutive Work periods. Such boxes shall be equipped to regulate the temperature in the range of 60 deg F to 80 deg F or 68 deg F to 78 deg F when the design compressive strength is 6000 psi or greater, and to provide the moisture to maintain the curing conditions specified in ASTM C31. During hot weather when the temperature is greater than 80 deg F, maintain the temperature of the concrete specimens in the required range by immersing them in a water bath. Cover the water bath to prevent direct sunlight from raising the water temperature. Completely remove and replace the water in the bath every day. Locate the boxes where directed by the Engineer. Protect boxes from vibration and other disturbances during specimen curing.

C. Keep this Specification and the following ACI publications available at all times at the construction site:

1. ACI 301.
2. ACI 302.1R.
3. ACI 305R.
4. ACI 306R.
5. ACI 308.
6. ACI 309R.
7. ACI 318.

D. Ensure that the concrete supplier keeps this Specification and the following ACI publications available at all times at the batching location:

1. ACI 211.
2. ACI 213.
3. ACI 304R.

E. Bonding New Concrete to Existing Concrete

Where new concrete will be placed against existing concrete surfaces:

1. Surface to receive concrete shall be soaked and kept wet with water for one (1) hour prior to placement of material. Puddles of standing water shall be removed immediately prior to placement.
2. A thin layer of material from the leading edge of the concrete being placed shall be broomed into the wetted surface. Care shall be exercised to ensure that all vertical as well as horizontal surfaces receive a thorough, even coating and that the rate of progress is controlled so that the broomed material does not dry before being covered with additional material as required for final grade.

F. Placing Concrete

1. Place concrete only in the presence of the Engineer and by methods approved by him.
2. For concrete cast against earth or an approved compacted subgrade, and for concrete overlays, place concrete against surfaces in a saturated surface dry condition.
3. Prior to placing concrete, remove all standing water or puddles.
4. Do not place concrete on or next to frozen surfaces.
5. Transfer concrete from mixer to place of deposit as rapidly as practical to prevent formation of cold joints.
6. Use equipment and methods for placing which permit rapid placement of concrete of the required consistency and which preclude segregation.
7. The method and equipment used to transfer concrete from mixer to forms will be subject to prior approval by the Engineer. Do not use any pipes, chutes or other equipment made of aluminum.
8. Subject to the foregoing requirements, convey concrete by approved conveyors, pipes, chutes or spouts to a point not more than five feet horizontally or vertically from its final position, unless otherwise approved by the Engineer.

9. Concrete for fill in steel reinforced pipe piles, steel shells or caissons shall be deposited using a metal (not aluminum) hopper and an elephant trunk. The hopper and elephant trunk shall be set above the top of piles, steel shells or caissons to permit the escape of air as the concrete is placed. Elephant trunks shall be removed in sections while filling piles, steel shells or caissons from bottom of reinforcing cage to top of piles, steel shells or caissons. Elephant trunks shall extend a minimum distance of 10 feet below top of pile, steel shell or caisson or to bottom of reinforcing cage, whichever is greater. The top 15 feet of the concrete poured from the top shall be vibrated or rodded. No cold joints will be permitted during concreting operations, unless otherwise noted on the Contract Drawings.

10. Except where otherwise approved by the Engineer, consolidate concrete by internal mechanical vibration subject to the following:

    a. Type, number and method of application of vibrators will be subject to prior approval by the Engineer.

    b. Apply vibrators at points not more than 30 inches apart for time intervals of approximately 10 seconds.

    c. Do not use vibrators to move concrete horizontally.

    d. In locations where spading is approved in lieu of mechanical vibration, spade coarse aggregate away from the forms and into the plastic mass; rod concrete around embedded materials and into corners and spaces to be filled and use only approved equipment.

    e. In locations where epoxy coated reinforcement is being used, use rubber tipped vibrators.

    f. Consolidation is typically not necessary for self-consolidating concrete; however, have internal vibrators on site. Obtain prior approval by the Engineer for the use of either internal or external vibrators

11. Prevent formation of laitance and accumulation of excessive water on surface of concrete as it is deposited. Remove any accumulated bleed water by approved means before placing other concrete.

12. Place concrete so as to require as little rehandling as possible. Place and spread concrete using an approved mechanical spreading device that prevents segregation of the materials. Place continuously between contraction joints. Perform necessary hand spreading with shovels, not rakes.

13. Place self-consolidating concrete in a continuous and timely manner so that it stays plastic and within slump-flow tolerance range during placement

14. Deposit concrete as near to joints as possible without disturbing them but do not discharge onto a joint assembly unless placement is centered above the joint assembly.

15. Thoroughly consolidate concrete against and along the faces of all forms and previously placed concrete and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Do not permit vibrators to come in contact with a joint assembly, base course or a side form. In no case shall the vibrators be used to move the concrete.

16. Screed and float concrete for riding surfaces as it is placed and use an approved evaporation retardant or fog spray.

17. Lightweight Concrete

a. Lightweight concrete shall not be pumped unless test results specified in Subsection 1.05.B.2.a confirm the acceptability of pumping lightweight concrete and pumping is approved by the Engineer. Otherwise, any lightweight concrete placed in the field must be deposited through a conveyor system or an approved equal.

b. All lightweight concrete must be maintained at a minimum of 50 deg F at all times until the design strength is reached. Temperature must be maintained through an external source of heat and/or proper insulation. Use of liquid admixtures to lower the freezing point of water is not acceptable.

c. In situ concrete temperature will be monitored by the Engineer to verify conformance.

d. For precast lightweight concrete, the members must be stored at a temperature greater than 50 deg F for a minimum of 30 days prior to exposure to freeze-thaw.

e. Any concrete that shows damage from freeze-thaw exposure as determined by the Engineer shall be removed and replaced.

f. No anti-freezing agents shall be added to the lightweight concrete.

G. Concrete Placing and Finishing Equipment for Bridge Decks and other Riding Surfaces

1. For slab or overlays 8 inches or more thick use internal vibrators. Internal vibrators shall be gang-mounted and supplemented with manual vibrators subject to the following:

a. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

b. Check all vibrators prior to the start of Work and periodically during construction progress to verify that they are working properly.

2. For slab or overlays less than 8 inches thick, vibrating surface pans or screeds will be allowed.

3. Manual tools such as bull floats, trowels, brooms and other similar hand tools are acceptable.

H. Consolidation and Finishing

1. Bridge Decks and other Riding Surfaces

a. Machine finishing shall conform to NJDOT Standard Specifications for Road and Bridge Construction 2007 Subsection 1005.02, .03 and .04 unless otherwise specified on contract drawings.

b. Finishing at and adjacent to joints shall conform to NJDOT Standard Specifications for Road and Bridge Construction 2007 Subsection 405.03.02 Item C.

c. Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade; (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded using an approved portable screed. Use a second screed shall for striking off the bottom layer of concrete when reinforcement is used.

The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal (not aluminum) or of other suitable material covered with metal. Consolidation shall be achieved by the use of suitable vibrators.

d. After the concrete has been struck off and consolidated, it shall be further smoothed and trued by means of a longitudinal float using one of the following methods:

(1) Long-handled floats shall be not less than 12 feet in length and 6 inches in width, stiffened to prevent flexibility and warping. The float shall be operated from foot bridges spanning but not touching the concrete or from the edge of the pavement. Floating shall pass gradually from one side of the bridge deck to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or laitance in excess of 1/8-inch thick shall be removed and wasted.

(2) The Contractor may use a machine composed of a cutting and smoothing float(s), suspended from and guided by a rigid frame and constantly in contact with, the side forms or underlying surface. If necessary, long-handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open-textured areas in the pavement. When the crown of the bridge deck will not permit the use of the mechanical float, the surface shall be floated transversely by means of a long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance in excess of 1/8-inch thick shall be removed and wasted. Successive drags shall be lapped one-half the length of the blade.

e. While the concrete is still in a workable condition, test it for trueness as specified in section 02510.

2. Specified concrete finishes, as shown on the Contract Drawings, shall be in accordance with the following requirements:

a. "Smooth Finish": A surface of concrete obtained by the use of special forms as specified in Division 3 Section entitled "Concrete Formwork". Remove all fins and other irregularities in the exposed surfaces of concrete by rubbing the irregularities with a carborundum brick and clean fresh water. Any mortar patches shall be rubbed with a carborundum brick as above specified.

b. "Scored Finish": A surface of concrete obtained by roughening in an approved manner or by etching with sharp-pointed steel tools to key or otherwise improve the mechanical bond of the surface. Such scoring shall roughen at least ten percent of the area so scored.

c. "Float Finish": A surface of concrete obtained by the use of a wood float. Apply float finish to horizontal surfaces immediately after screeding and before initial setting has begun.

d. "Trowel Finish": A surface of concrete obtained by the use of a steel trowel, after screeding and floating the surface of the concrete to produce a dense, smooth, even surface suitable for painting or the application of floor covering. The troweling shall not take place until the surfaces have set sufficiently to sustain knee boards without damage. Troweling shall eliminate all irregularities and leave the concrete surface with a smooth, hard finish, free from marks and blemishes to the satisfaction of the Engineer.

e. "Traction Finish": A monolithic layer of abrasive concrete having a minimum thickness of 3/4 inch and which shall be "Emericrete SH", as manufactured by the Sika Corporation, or approved equal. Prepare the base and install the monolithic finish in accordance with the recommendations of the manufacturer of the abrasive concrete. The surface shall be given a wood float finish. The sides and edges of pavement slabs shall be rounded with an approved edging tool to the minimum radius obtainable in the sole opinion of the Engineer.

f. "Burlap Finish": A surface of concrete obtained by the use of a burlap drag, after screeding and floating the surface of the concrete. Drag the burlap in one direction in a straight line before initial setting has begun and in such a manner that the full width of the slab being finished is dragged in one operation. Prepare the surface prior to dragging by working from a bridge that does not come in contact with the fresh concrete at any point. The use of any burlap that causes irregularities or grooves greater than 1/16 inch in depth in the concrete surface will not be permitted. Rinse or wash burlap as often as is necessary to prevent the presence of hardened particles and consequent scarring of the concrete.

g. Stair treads and platforms of steel stairs shall be filled with mortar mixed in the proportions of one part Portland cement to three parts of fine aggregate, mixed with water to a satisfactory consistency. Coat the surface of the mortar with three pounds of aluminum oxide crystals per square yard of surface, uniformly applied, and trowel the surface to a smooth hard finish. Aluminum oxide crystals shall be grade AL203 crystals ranging from No. 12 to No. 30 in size and shall contain not more than six percent of iron or other impurities.

h. "Broom Finish" shall be subject to the following:

(1) Finish the concrete when the water sheen has practically disappeared. Use push broom or floor brush type, not less than 18 inches wide and made of good quality bass or bassine fibers not more than 4-1/2 inches long and with handles longer than half the width of the slab.

(2) Use an adequate number of brooms to keep up with other operations. Achieve proper finish prior to initial set of the concrete.

(3) Wash and thoroughly dry brooms at frequent intervals and remove worn or damaged brooms from the construction site.

(4) Draw broom across previously finished surface from the centerline to each edge of the slab with a slight overlap of strokes.

(5) Corrugations made in surface shall be uniform, approximately 1/16 inch in depth, and not more than 1/8 inch in depth.

(6) Complete brooming before concrete reaches a condition that would result in the surface becoming torn or unduly roughened and before initial set of concrete.

(7) Immediately following brooming, carefully finish the edges of slab along sides and at joints with an approved edging tool to form a smooth rounded surface of required radius and subject to the following:

(a.) Where corners or edges of slabs have crumbled and at any areas which have leaked sufficient mortar to make proper finishing difficult, remove loose fragments and soupy mortar, fill solidly with a mixture of correct proportions and consistency and finish.

(b.) Edges shall be smooth, true to line and free of unnecessary tool marks.

i. "Saw Cut Grooved Surface" for deck slabs and overlays shall conform to the requirements of the NJDOT Standard Specifications, Division 500 Subsection 507.03.02, Item L.

j. Concrete Curbs and Sidewalks

(1) Give sidewalks a "Float Finish", tool edges and joints for a width of 2 inches and round corners to a radius of 1/4 inch with an approved edging tool.

(2) Install expansion joints at not more than 20-foot intervals in sidewalks with matching joints in curbs. Use 1/4-inch bituminous joint filler.

(3) Score sidewalks in squares as approved by the Engineer.

I. Pump Concrete

1. Grout used to prime the pump line shall not be included in the placement. Dispose of the grout at the end of the pump line off Authority property. Do not begin placement until concrete is visible at the end of the pump line.

2. Allow no water to enter the pump hopper at any time during placement operations.

3. Submit written procedures for pumping to the Engineer for approval. The procedures shall contain, but shall not be limited to, pumping scheme, pump description, line diameter, line length and the number of turns and line offsets.

J. Silica Fume Concrete and Fibrous Concrete

1. Arrange for qualified technical representatives from the silica fume and the fiber suppliers, who are experienced in the batching and placement of silica fume and fibrous concrete, to be present for the pre-concrete construction meeting, all test pours and the first two production pours.

K. Fog spray forms, steel reinforcement and subgrade with potable water immediately prior to the placement of fresh concrete. Maintain uniform moisture of the subgrade without standing water, soft spots or dry areas.

3.04 CURING

A. Carefully cure all concrete. Submit a curing procedure plan for approval by the Engineer prior to placing any fresh concrete. Include measures taken to cure lightweight concrete. Perform curing in accordance with ACI 308 and the following specifications. Commence curing procedures immediately after fresh concrete has been placed.

1. Provide suitable means, such as insulating blankets or heated enclosures, for maintaining a concrete temperature of at least 50 deg F after placement. At the end of this period, remove protection in such a manner that the drop in temperature of any portion of concrete is gradual and does not exceed the following within the first 24 hours after removal of protection, in accordance with ACI 306R, Table 3.1: 50 deg F for applications with a minimum dimension less than 12 inches; 40 deg F for applications with a minimum dimension between 12 and 36 inches; 30 deg F for applications with a minimum dimension between 36 and 72 inches; and 20 deg F for applications with a minimum dimension greater than 72 inches.
2. Allow all concrete to attain 4,000 psi compressive strength before exposure to freeze-thaw cycles.
3. Any concrete that shows damage from freeze-thaw exposure as determined by the Engineer shall be removed and replaced.
4. Choice of curing material and method shall be as approved by the Engineer. For lightweight concrete, temperature shall be maintained through an external heat source. Use of liquid admixtures that lower the freezing point of water is unacceptable.

B. Wet Curing

1. All structural slabs and bridge decks: Immediately after screeding of the concrete and when there is no free water on the concrete surface, apply 2 coats of curing-membrane. After final set, commence wet curing for 7 days.
2. Perform wet curing for the following concrete applications: overlays, deck slabs, ramps, any concrete mixes containing silica fume, Very High Early Strength Cement and formulated latex modifier.
3. Immediately after finishing concrete, cover the surfaces with wet burlap or cotton mats which have been presoaked for a minimum of 24 hours in potable water, so that no marring of the surface occurs. Keep the burlap or cotton mats continuously moist, 24 hours per day, through the use of a fog spraying system or soaker hoses arranged at the high points of the concrete pour. Burlap, which shall consist of two or more layers, or cotton mats shall overlap a minimum of one foot, and shall be at least one foot longer than necessary to cover the entire width and edges of the pavement lane. The burlap or cotton mats shall be weighted down to prevent displacement.
   a. Inspect sheet material before reuse. Repair all holes and tears with cemented patches, subject to approval by the Engineer.
4. Wet curing procedures may be stopped only (1) when the ambient temperature is expected to fall below 35 deg F within 24 hours, (2) when placing concrete for slabs directly adjacent to the fog spraying system or soaker hoses or (3) when concrete is to receive traffic.
   a. When the ambient temperature at the surface of placement is 35 deg F and falling, wet curing will not be permitted; instead, apply a liquid membrane forming curing compound in accordance with 2.02 R and 3.04 C.1.a.

b. When wet curing is temporarily interrupted for an adjacent placement, remove all standing water in areas to receive fresh concrete prior to placement. Occasionally spray a fine mist of water over the wet curing areas. Do not puddle water on the surface of the fresh concrete. When the fresh concrete is finished and covered with burlap or cotton mats, reassemble the continuous fog spraying system or soaker hoses and continue wet curing immediately.

c. Areas in which the concrete will be exposed to traffic shall be wet cured for as long as possible. Wet curing may stop only when there is just enough time to apply a liquid membrane forming curing compound over the entire area prior to reopening it to traffic. In this case, apply the liquid membrane forming curing compound when the surface has no standing water or puddles on the surface, but is in a damp condition.

5. Wet cure bridge decks for 7 days, or until 75% of the design compressive strength is obtained, whichever is longer, when determined by strength tests performed on sample cylinders cast in the field and cured in the same manner as the concrete.

6. Immediately after wet curing procedures are completed, apply a liquid membrane forming curing compound in accordance with 2.02 R and 3.04 C.1.a.

7. Contain water within the area of work.

8. For latex modified concrete, wet cure for a maximum of 48 hours, unless otherwise directed by the Engineer.

C. Liquid Membrane Forming Curing Compounds and Sheet Materials for Curing

1. Immediately after placing or finishing and when there is no free water on the concrete surface, commence the curing process of concrete not covered by forms from loss of moisture. Use one of the curing materials listed in 2.02 R, which may be supplemented by initially using an evaporation retardant listed in 2.02 S, as long as wet curing is not required, subject to the following:

a. Apply white pigmented liquid membrane forming curing compound as soon as surface moisture has evaporated by approved pressure spraying or distributing equipment in two uniform full applications perpendicular to each other as recommended by the manufacturer. Allow the first coat to become tacky before applying the second coat. Each application shall be the full quantity recommended by the manufacturer. The entire surface shall be white after the second application.

(1) Recoat areas subjected to heavy rainfall within 3 hours after rain.

(2) Follow manufacturer's recommendations for agitation during application and warming where necessary during cold weather. Do not use liquid membrane forming curing compound where the surface being cured is to receive a finish that will be bonded to the concrete surface or where a floor hardener is to be applied, unless a certification of compatibility and a minimum five-year performance record is submitted in advance to the Engineer for approval.

(3) The Engineer will check for uniformity through random sampling and testing. Testing may include determination of membrane infrared spectrum, pH, specific gravity and solids content.

2. Removal of Forms: Removal of forms shall be subject to the following:

   a. After removal of forms, patch areas of concrete which in the opinion of the Engineer show excessive honeycomb by cutting out defective areas, keying and refilling them with a mortar of cement and sand in the same proportions as those in the approved concrete mix design and sufficient water to provide a workable mix.

   b. Immediately after forms are removed, apply curing compound on the concrete and cure in accordance with 3.04 C.

   c. Immediately after removal of forms, holes and voids in the surfaces of concrete, resulting from bolts and ties, shall be wetted and filled with a mortar containing cement and fine aggregate in the same proportions as in the approved concrete mix design, and utilizing cement which shall produce mortar of the same color as the concrete. Exposed mortar surfaces shall then be finished smooth and even with a wood float, except that those surfaces exposed to view in the finished structure shall be finished with a steel trowel to match adjacent surfaces. All fins and other surface irregularities shall be removed promptly by chipping, grinding or other methods approved by the Engineer to give a uniform finish. Where no specific surface finish for formed concrete surfaces is indicated on the Contract Drawings, no further finishing will be required.

   d. Drop in concrete surface temperature over the first 24 hours shall be controlled in accordance with ACI 306.

D. Curing and Protection of Mass Concrete

1. After placement, control the concrete temperature and the temperature difference within the concrete to meet the requirements outlined in section 2.04 C herein.

2. Unless otherwise specified, place one temperature sensor at the center of mass of placement and one temperature sensor at a depth 2 in from center of nearest exterior surface. Place an additional sensor at each location to serve as a backup in the event the other temperature sensor fails. In addition, provide a temperature sensor in a shaded location for monitoring ambient on-site temperature.

3. Unless otherwise specified, monitor temperatures hourly using electronic sensors capable of measuring temperature from 32 deg F to 212 deg F to an accuracy of 2 deg F. Ensure temperature sensors are operational before placing concrete. Unless otherwise specified, provide data from sensors to Owner on a daily basis, until temperature requirements specified herein are met.

4. Compare temperatures and temperature differences with maximum limits specified herein every 12 hours. If either exceeds specified limits, take immediate action as describes in the approved Thermal Control Plan to remedy the situation. Do not place additional mass concrete until cause of excessive temperature or temperature difference has been identified and corrections are acceptable.

3.05 QUALITY ASSURANCE TESTING, SAMPLING AND INSPECTIONS

A. The Engineer will perform Quality Assurance testing during mixing and placing of concrete on samples taken from the end of the pump line or at the point of discharge in accordance with ASTM C172. The Engineer will take samples of concrete from each Lot during a single Work period based on random sampling procedures contained in ASTM D 3665. A Lot of concrete is defined as the production of a single Work period. For each Sublot, the Engineer will cast cylinders in accordance with ASTM C31 when testing for compressive strength, as well as 4" x 8" cylinders when permeability is being tested and beams when flexural strength is being tested. The cylinders and beams will be tested in accordance with ASTM C39 and ASTM C78, respectively, for each Sublot to determine the compressive strength and flexural strength at the time requirements specified.

TABLE 1

LOTS AND SUBLOTS

Daily Placement Quantity (Cubic Yards)	Number of Lots	Number of Sublots
Less than 50	Note 1	Notes 1 and 3
50 – 100	1	3 equally divided
101 – 450	1	4 equally divided
Greater than 450	1	Note 2

Table 1 Notes:

1. If one Work period's placement of a given Class of concrete is less than 50 cubic yards, it will not constitute a Lot. It will be added either to the previous or the next Work period's Lot, whichever is closer in time, or until a minimum of 3 Sublots are completed constituting a Lot.

2. For concrete placements of 450 cubic yards or greater, a Sublot will be deemed to be one fourth of a Lot of concrete, or 150 cubic yards of concrete, whichever is less. For larger pours the Engineer may increase the number of cubic yards that constitute a Sublot.

3. If the total concrete quantity under the Contract for any type of mix is less than 50 cubic yards, it will constitute one Lot and will be divided into a minimum of 3 Sublots, regardless of the placement schedule.

B. Quality Assurance Testing Standards and Frequency of Testing: Some or all of the following procedures will be used by the Engineer to approve the concrete mix proportions and evaluate the in-place concrete for Adjustments to Contract Compensation:

1. Compressive Strength: In accordance with ASTM C31 and ACI 318 Part 3, Chapter 5, Item 5.6, entitled "Evaluation and Acceptance of Concrete", except that the Engineer will take samples on a random basis and 4" x 8" cylinders will be used when the nominal maximum size of the coarse aggregate allows. Modify the consolidation method of ASTM C31 for samples for self-consolidating concrete by placing the concrete in the molds in one layer without vibration or tamping.

Latex Modified Concrete samples will be wet cured by the Engineer for 1 day and dry cured for 27 days. The cylinders will be tested in accordance with ASTM C39. The Engineer will calculate the average of two test specimens at the compressive strength time requirement. The average of the two test specimen result values for each Sublot will be considered the Sublot compressive strength value.

2. Flexural Strength: From each Sublot sample, cast beams in accordance with ASTM C31. The Engineer will test the beams in accordance with ASTM C78 and will calculate the average of two test specimens at the flexural strength time requirement. The average of the two test specimen result values for each Sublot will be considered the Sublot flexural strength value. For light weight concrete, use splitting tensile strength in lieu of flexural strength (ASTM C496).

3. Slump Test: Performed by the Engineer at the point of delivery during the time of placement in accordance with ASTM C1611 and ASTM C1621 when self-consolidating concrete is used. For Latex Modified Concrete, the Engineer will perform slump tests 5 minutes after sampling from the mixer. For pile concrete applications, the slump shall be no less than 4 inches and no greater than 6 inches.

   For self-consolidating concrete used in drilled shafts, the slump flow shall be between 18 and 24 inches, with slump flow retention of no less than 16 inches. Self-consolidating concrete used in drilled shafts shall also exhibit a passing ability of no greater than 1.5 inches of slump flow difference. Visual stability index and passing ability testing shall be performed at the same rate as the slump flow test.

4. Air Content Test: Performed during the placement in accordance with ASTM C138, ASTM C173 or ASTM C231. The Engineer will perform one test for each Sublot, which will be considered the Sublot air content test value.

5. Unit Weight: The Engineer will determine the plastic unit weight of concrete (taken at the same frequency as specified in 3.05 B.4 according to ASTM C138). For lightweight concrete, the plastic unit weight, as determined in accordance with ASTM C567, shall not exceed the acceptable plastic unit weight value determined by the Engineer based upon the approved mix design, unless otherwise specified.

6. Water Content Test: The Engineer will test for water content during the placement using a Microwave Drying Oven, in accordance with AASHTO T 318. He may adjust drying times depending on the mix constituents to achieve a constant dry weight. Once the water content has been determined, it will be divided by the cementitious content in the mix design to determine the water to cement ratio. When the maximum aggregate size exceeds 1-1/2 inches, the Engineer will obtain a sample of approximately 10,000 grams depending on aggregate size. This sample will be split and the Engineer will perform two separate analyses. The weighted average of the two separate analyses will be considered the Sublot water content value. Likewise, the Engineer will compute the sublot water cement ratio as given above.

   a. When results for either two consecutive tests or three tests in one lot or one day's production indicate that the water content exceeds the limits given in 2.03 A.4 by 0.05, do not place the next load until it has first been tested and satisfactory test results have been obtained. If the water content for this load is greater than the Upper Limit given in 2.04 A.5, it will be rejected. The Engineer will test subsequent loads until the water content is found to be within the limit given in 2.04 A.5.

7. Coulomb Test: To evaluate the permeability of the concrete the Upper Quality Limit, UQL, shall be 1000 Coulombs, as tested by the Engineer in accordance with AASHTO T 277 using the accelerated method (7 day normal cure at 73°F, 21 days wet cure at 100°F). For Latex Modified Concrete applications, samples will be wet cured for 7 days and dry cured for 21 days. For each Sublot, the Engineer will cast two (2) 4" x 8" cylinder specimens for each Sublot. The Engineer will cut 2-inch thick samples from the center of each cylinder for testing. The average of the two test specimen result values for each Sublot will be considered the Sublot Coulomb test value.

8. Bond Strength: The bond strength between overlay concrete and parent concrete will be evaluated in accordance with ASTM C1583. For each Sublot, the Engineer will perform three tests. Three 4-inch diameter cores will be cut 1/2 inch into the parent concrete to isolate the overlay concrete. The average of the three test result values for the Sublot will be considered the Sublot bond strength test value. The locations for each test will be randomly determined by the Engineer.

9. Chloride Ion Concentration by Weight of Cement: The Engineer may perform testing for both the acid soluble and water soluble chloride ion concentrations by weight of cementitious material, which will be evaluated as follows. Powder samples from 28-day concrete cylinders, cast from the concrete mix delivered to the construction site, will be tested to assess both the acid soluble and water soluble chloride ion concentrations by weight of cementitious material. Samples will be obtained using a rotary hammer drill from the mid-height of a minimum of two Sublot specimens from each Lot. The sample will be obtained from the inner three inches of the cylinder specimen, and must be a minimum of 40 grams in weight. The acid soluble and water soluble chloride ion concentrations by weight of cementitious material will be determined by the Materials Engineering Unit in accordance with preparatory standards ASTM C1152 and ASTM C1218, respectively, followed by ASTM C114 (silver nitrate titration) for both the acid soluble and water soluble chloride ion analysis.

10. Pavement Thickness: The Engineer will perform acoustical testing using Impact Echo instrumentation to determine the pavement thickness. Areas indicating pavement thickness below the requirements shown on the Contract Drawings will be cored for verification. The cores will be measured in accordance with ASTM C174. The average of three test result values for the Sublot will be considered the Sublot test value.

11. Cracking: The Engineer will perform visual inspection of all concrete members to determine extent of cracking. Areas that do not meet the requirements outlined in section 2.04 herein will be removed and replaced, or repaired through an approved method, as determined by the Engineer. Precast members will be inspected at the plant prior to shipping. Any precast member with cracking as determined by the Engineer will be rejected.

12. Where specified the Engineer will place Remote Temperature Sensing Devices in the in situ concrete to record maximum core temperature and maximum drop of temperature for 24 hours after protection has been removed.

13. Test Cores for Tremie Concrete

a. The Engineer will drill test cores for every 100 cubic yards of concrete placed in mass pours, such as tremie seal, or one core for every 1000 square feet of surface of thin pours, such as bulkheads or wall facings. Cores will be obtained in accordance with ASTM C42 and will be drilled full depth (or thickness) through the pour horizontally or vertically as applicable.

b. Requirements and frequency of test concrete core for drilled shafts shall be in accordance with Specifications Section 02378 Drilled Shafts.

c. Recovery of less than 95 percent will be considered to indicate defective concrete requiring corrective action by the Contractor.

d. If the cores reveal voids, honeycombing, seams or other defects, the concrete will be subject to rejection for non-uniformity. Additional cores may be obtained by the Engineer for further investigation. The number and location of cores will be determined by the Engineer. All additional cores will be taken at the sole expense of the Contractor.

e. Fill all test core holes by pressure grouting from the bottom upward, or from the inside out, as the case may be.

f. Clean out and fill all voids, honeycombing, seams and other defects by pressure grouting with cement or sand-cement to the Engineer's satisfaction. At the Engineer's request and at the sole expense of the Contractor, drill additional cores to verify grouting.

14. Mock-ups for Mass Concrete

a. Mock-ups shall be a minimum size of 10 foot by 10 foot by the smallest dimension exceeding the smallest dimension on site.

b. Mock-ups shall be located as directed by the Owner.

c. Mock-ups may be a net cost item.

d. Testing and temperature instrumentation shall be provided by the Owner

e. Concrete mixes that are determined not to satisfy the specified design parameters as per contract documents shall be modified and mocked-up at no additional cost to the Owner.

f. The Contractor shall remove and legally dispose of all mock-ups when directed by the Owner.

C. In accordance with the Section of Division 1 entitled "Inspections and Rejections", provide labor and means for obtaining all samples required for trial batches and field testing performed by the Engineer. At no additional cost to the Authority, furnish and deliver the following when requested by the Engineer:

1. Provide a representative sample, in the quantity requested by the Engineer, of all cement, fly ash, slag, silica fume, fine and coarse aggregate, admixtures, corrosion inhibitor, latex, fibers, pigment, evaporation retardant and liquid membrane forming curing compound during any day of production the Engineer requests a sample. Take such samples in the presence of the Engineer at the point of storage used for the Work of this Contract. For cement, fly ash, slag and silica fume samples, only use a sampling port on the silo, or drop material in a loader bucket between loads, or take samples from the boot using a "Sample Thief" during loading. Notify the Engineer of aggregates being loaded at their source of supply at least 48 hours in advance of each loading.

2. Provide the cement, fly ash, slag, silica fume or metakaolin manufacturer's Mill Test Certificate and Bill of Lading, if such documents are requested by the Engineer.

3. Allow the Engineer to sample any mix proportion constituents at any time.

D. The Engineer may direct an inspection of the Contractor's concrete plant or precast concrete fabricator to observe operations and review the Quality Control procedures being implemented. Notify the Engineer, in writing, a minimum of 15 days prior to the commencement of production and submit a schedule and Quality Control Plan for all production for the Work of the Contract.

E. Precast Concrete: Obtain from the fabricator and submit to the Engineer a set of approved shop drawings for the Work of the Contract. Fabrication without shop drawings will not be permitted. Clearly mark all precast units with identification numbers for each unit. The Engineer will provide a manifest ticket to be attached to the driver's shipping ticket listing the approved unit identification numbers. Any units shipped to the construction site that are not approved or are not listed on the manifest will not be permitted to be unloaded at the construction site. Shipments not accompanied by a manifest upon delivery will not be permitted to be unloaded at the construction site.

F. For concrete where riding surface tolerances are required, other than pavements, as indicated on the Contract Drawings, follow the requirements of specification Section 02510.

G. Specified concrete finishes, as shown on the Contract Drawings, must conform to the requirements set forth in 3.03 H.2. Correct all deficiencies as specified in 4.01.I and at no cost to the Authority.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Unless otherwise shown on the Contract Drawings, acceptance of material will be based on the method of estimating Percentage of Lot Within Specification Limits (PWL), where the PWL will be determined in accordance with this Section. All Sublot test result values for a Lot, as defined in 3.05 A, Table 1, will be analyzed statistically to determine the total estimated Percent of the Lot that is Within specification Limits, as shown in 4.01 B. The PWL is computed using the Lot sample Average value, $\overline{X}$, as defined in 4.01 D.3 and the Lot sample standard deviation, S_N, as defined in 4.01 D.4, for the specified number of Sublots, n, and for the specification Quality Acceptance Limits, as defined in 2.04 A, where LQL represents the Lower Quality Limit, and UQL represents the Upper Quality Limit, as they apply to each particular acceptance parameter. From these values, the respective Quality Index(ices), Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed in accordance with 4.01 D.5 and 4.01 D.6. Then the PWL for the Lot for the specified number of Sublots, n, is determined from Table 4, "Percent of Lot Within Limits (PWL) (Standard Deviation Method)". The Adjustment to Contract Compensation for each Lot is then calculated using the formulas specified in 4.01 F.

B. Depending on the application, concrete will be tested for the properties shown below. The PWL of each Lot for each parameter will be determined as specified in 4.01 D. Payments will be based on the concrete application for a Lot and the criteria defined below.

Performance Parameters	Minimum PWL
Flexural Strength	95
Splitting Tensile Strength***	95
Compressive Strength	95
Permeability	90
Bond Strength	80
Water to Cement Ratio	80
Air Content	70*
Pavement Thickness	90
Chloride Content	100**

*denotes that in addition to the minimum PWL, the air content will also be evaluated for the average of test results for a given Lot of concrete as per 3.05 B.4 and 4.01 J.

**denotes that the chloride content (acid soluble and water soluble) will be analyzed only for the average of test results for any given Lot of concrete, as per 3.05 B.9 and 4.01 G.1.b.

***for use with light weight concrete only in lieu of flexural strength

Table 2 defines the Quality Acceptance performance criteria to be evaluated for Adjustments to Contract Compensation for a given concrete application. In addition, all concrete shall conform to the requirements of 4.01 G. Any deficiencies found to exist as specified in 4.01 G will govern and the Contractor shall either:

TABLE 2
PERFORMANCE CRITERIA PARAMETERS

Category/ Application	Water/Cement Ratio (W/C)	% Air	Permeability	Bond Strength	Compressive Strength	Flexural Strength	Pavement Thickness
Category I - Full Depth Pavements & Unbonded Overlays							
	I	I	---	---	---	P	
LQL:	---	*	---	---	---	700 psi	97%
UQL:	0.45	*	---	---	---	---	---

Category II - Bonded Pavement Overlays

	I	I	---	P	I	---	---
LQL:	---	*	---	150 psi	***	---	---
UQL:	0.45	*	---	---	---	---	---

Category III - Elevated Structural Overlays

	I	I	I	P	I	---	---
LQL:	---	*	---	150 psi	***	---	---
UQL:	0.45	*	**	---	---	---	---

Category IV - Structural (exposed to freeze-thaw and/or sulfates, in addition to chlorides or a marine environment)

	I	I	P	---	I	---	---
LQL:	---	*	---	---	***	---	---
UQL:	0.45	*	**	---	---	---	---

Category V - Structural (exposed to freeze/thaw and/or sulfates only; no exposure to chlorides or a marine environment)

	I	I	---	---	P	---	---
LQL:	---	*	---	---	***	---	---
SQL:	0.45	*	---	---	---	---	---

Category VI - Standard Structural (not exposed to freeze-thaw cycles) and Miscellaneous Applications (at-grade sidewalks, at-grade curbs, kerfs, foundations, footings, drainage structures, manholes, pipe pile fill and all concrete applications below grade)

	---	---	---	---	P	---	---
LQL:	---	---	---	---	***	---	---
UQL:	---	---	---	---	---	---	---

* - Refer to 2.04 A.6.
** - 1000 Coulomb count using the accelerated method.
*** - The proportion compressive strength at 28 days or as specified on the Contract Drawings.
P - Used to Calculate Pay Factor per cubic yard. It denotes the concrete property that will be used to calculate payment for a given concrete application. No incentive payments will be made if the performance criteria parameters labeled 'I' for a given application have a PWL less than specified in 4.01 B.
I - Used to Calculate Incentive only when the Pay Factor for the parameter labeled 'P' is greater than 0.00.

C. Full Depth Pavement and Unbonded Overlay (Category I) Final Pay Factor: The Pay Factor for Pavement Thickness will govern only when the Pay Factor for Pavement Thickness is less than the Pay Factor for Flexural Strength, with the exception of when the Pay Factor for Pavement Thickness is 0.00.

D. Method of Estimating Percentage of Material Within Limits (PWL)

1. Locate sampling positions on the Lot by use of random sampling procedures specified in 3.05 A.
2. Take a test sample and make the test specimens on the test sample in accordance with 3.05 A.

3. Determine the Lot sample Average value, $\overline{X}$, by calculating the average of all Sublot test values.

4. Find the Lot sample standard deviation, S_N, by using the following formula:

$$S_N = \sqrt{\frac{d_1^2+d_2^2+d_3^2+ +d_n^2}{n-1}}$$

Where:

S_N = standard deviation of the Sublot test values

$d_1, d_2....$ = deviation from the individual Sublot test values

$X_1, X_2, ...$ from the Average value, $\overline{X}$, that is,

$d_1 = (X_1 - \overline{X}), d_2 = (X_2 - \overline{X}), ..., d_n = (X_n - \overline{X})$

n = number of Sublots

5. Find the Lower Quality Index, Q_L, by subtracting the Lower Quality Limit, LQL, from the Average value, $\overline{X}$, and dividing the result by S_N.

$$Q_L = \frac{\overline{X} - LQL}{S_N}$$

6. Find the Upper Quality Index, Q_U, by subtracting the Average value, $\overline{X}$, from the Upper Quality Limit, UQL, and dividing the result by S_N.

$$Q_U = \frac{UQL - \overline{X}}{S_N}$$

7. The percentage of material above lower tolerance limit, P_L, and the percentage of material below upper tolerance limit, P_U, will be found by referring to Table 4, "Percent of Lot Within Tolerance Limit (PWL) (Standard Deviation Method)". Locate Q_L and/or Q_U in the column appropriate to the total number of Sublots, n, and reading the number under the column heading "PWL".

8. For concrete properties with only an Upper Quality Limit (ratio of water to cementitious material, permeability), PWL equals P_U. For concrete properties with a Lower Quality Limit (bond strength, compressive strength, flexural strength, pavement thickness), PWL equals P_L. For concrete properties with both Upper and Lower Quality Limits (air content), first calculate of the Upper Quality Index, Q_U, and the Lower Quality Index, Q_L, by using the Upper Quality Limit, UQL, and the Lower Quality Limit, LQL, respectively, as stipulated in 2.03 A.6. Then determine PWL using the following formula:

$$PWL = (P_U + P_L) - 100$$

E. Pay Factors for each Lot will be computed in accordance with the formulas contained in 4.01 F, Table 3 entitled, "Adjustments to Contract Compensation", by entering the PWL value and performing the calculation indicated for the appropriate PWL range to determine the Pay Factor.

F. Adjustments to Contract Compensation shall be calculated as follows:

TABLE 3

ADJUSTMENTS TO CONTRACT COMPENSATION PER CUBIC YARD

Percent Within Limits (PWL)	Compressive Strength Pay Factor
98 - 100	0.02 (PWL-100) +0.06
95 - 97	0.0
55 - 94	(PWL-95)/100
0 - 54	-0.50

Percent Within Limits (PWL)	Permeability & Bond Strength Pay Factor
91 - 100	0.006 (PWL - 90)
80 - 90	0.0
55 - 79	$0.00017PWL^2 - 0.0105PWL - 0.30$
0 - 54	-0.50

Percent Within Limits (PWL)	Flexural Strength Pay Factor
95 - 100	(PWL-95/100)+.01[1]
55 - 94	(PWL-95)/100
0 - 54	-0.50

Percent Within Limits (PWL)	Pavement Thickness Pay Factor
90 - 100	0.00
55 - 89	(PWL-90)/100
0 - 54	-0.50

[1] Use also for splitting tensile strength of light weight concrete

Pay Factors are multiplied by the Base Price per cubic yard established in the table below, unless otherwise indicated on the Contract Drawings. The result is the amount to be added or deducted from the compensation for that particular Lot of concrete.

Category	Base Prices for Adjustments to Contract Compensation Per Cubic Yd
I	$100
II	$90
III	$130
IV	$130
IV	$110 when silica fume or metakaolin are not included
V	$90
VI	$80

G. Correction or Cost Adjustments for Deficiencies

1. Remove and Replace Concrete: Remove and replace concrete in a manner approved by the Engineer and at no additional cost to the Authority if any of the following deficiencies exist, unless the Engineer elects to accept the concrete, at which time the Contractor will be compensated at 50% of the Base Price per cubic yard, regardless of the Pay Factors calculated in 4.01 F, Table 3:

a. Percent Within Limits (PWL) for compressive strength, flexural strength, permeability, bond strength or pavement thickness is below 55.

b. The average acid soluble chloride ions by weight of cementitious material test results for any given Lot of concrete exceed the limit of 0.10% (reinforced concrete) or 0.08% (prestressed concrete) weight of chloride ions by weight of cementitious material, in accordance with ASTM C1152 and ASTM C114, and the average water soluble chloride ions by weight of cementitious material test results for any given Lot of concrete exceed the limit of 0.08% (reinforced concrete) or 0.06% (prestressed concrete) weight of chloride ions by weight of cementitious material, in accordance with ASTM C1218 and ASTM C114. The Soxhlet test referenced in ACI 222R will not be considered for chloride evaluations.

c. For all concrete applications, the cylinder compressive strength shall conform to the following:

(1) The calculated average of any three consecutive compressive strength tests shall be equal to or shall exceed the specified compressive strength.

(2) No individual compressive strength test result shall be below the specified compressive strength by more than 500 psi. When the required strength is 5000 psi or less, or by more than 0.10 of the specified strength when greater than 5000 psi is required.

(3) If either or both of the requirements specified in 4.01 G.1.c.1 and 4.01 G.1.c.2 are not met, investigate the in-place compressive strength in accordance with ACI 318-02, Section 5.6.5, at no additional cost to the Authority. If the compressive strength test results of the in-place concrete fail to meet either or both of the requirements specified in 4.01 G.1.c.1 and 4.01 G.1.c.2, the concrete will be considered deficient, and 4.01 G.1 will apply.

d. Concrete slabs or structures that exhibit any cracks prior to opening to vehicular/aircraft operations or loading will be subject to the actions specified in 4.01 G.1. If the concrete is accepted by the Engineer, seal cracks in accordance with Specification Section 03734 entitled "Concrete Crack Repair" in a manner approved by the Engineer, and at no cost to the Authority.

e. Delamination Testing: The Engineer will check all concrete overlays using the chain drag method in accordance with ASTM D 4580. If more than 5.00% of the total surface area of the Lot is found to be delaminated, remove these areas and replace them at no cost to the Authority. The determination by the Engineer as to the existence of delaminations shall be final and binding.

f. Slabs showing high or low spots between 1/8 inch to 1/4 inch when tested in accordance with 3.05 F.2.

H. If concrete finishes do not meet the requirements set forth for the specified finishes, refinish the hardened concrete as directed by the Engineer, at no additional cost to the Authority.

I. If the average air content for a Lot exceeds either the LQL or the UQL by more than 1% (with the exception of concrete not exposed to freeze/thaw cycles) 10% of the Base Price per cubic yard will be deducted from the compensation for that particular Lot of concrete.

J. If the core temperature of the in situ concrete exceeds 160 deg F, the Engineer will evaluate concrete quality using cores taken from the concrete in question. The cores will be tested in accordance with ASTM C42 and their compressive strength results will be used to calculate the PWL for payment adjustments.

TABLE 4

PERCENT OF LOT WITHIN TOLERANCE LIMIT (PWL)

(STANDARD DEVIATION METHOD)

Positive Values of Quality Index (QI)

(n = Number of Sublots in the Lot)

PWL	n=3	n=4	n=5	n=6	n=7	n=8
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4716
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630
87	1.0597	1.1100	1.1173	1.1191	1.1199	1.1204
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015
83	.9939	.9900	.9785	.9715	.9672	.9643
82	.9749	.9600	.9452	.9367	.9325	.9281
81	.9550	.9300	.9123	.9025	.8966	.8928
80	.9342	.9000	.8799	.8690	.8625	.8583
79	.9124	.8700	.8478	.8360	.8291	.8245
78	.8897	.8400	.8160	.8036	.7962	.7915
77	.8662	.8100	.7846	.7716	.7640	.7590
76	.8417	.7800	.7535	.7401	.7322	.7271
75	.8165	.7500	.7226	.7089	.7009	.6958
74	.7904	.7200	.6921	.6781	.6701	.6649
73	.7636	.6900	.6617	.6477	.6396	.6344
72	.7360	.6600	.6316	.6176	.6095	.6044
71	.7077	.6300	.6016	.5878	.5798	.5747
70	.6787	.6000	.5719	.5583	.5504	.5454
69	.6490	.5700	.5423	.5290	.5213	.5164
68	.6187	.5400	.5129	.4999	.4924	.4877
67	.5878	.5100	.4836	.4710	.4638	.4592
66	.5563	.4800	.4545	.4424	.4354	.4310
65	.5242	.4500	.4255	.4139	.4073	.4031
64	.4916	.4200	.3967	.3856	.3793	.3753
63	.4586	.3900	.3679	.3575	.3515	.3477
62	.4251	.3600	.3392	.3295	.3239	.3203
61	.3911	.3300	.3107	.3016	.2964	.2931
60	.3568	.3000	.2822	.2738	.2691	.2660
59	.3222	.2700	.2537	.2461	.2418	.2391
58	.2872	.2400	.2254	.2186	.2147	.2122
57	.2519	.2100	.1971	.1911	.1877	.1855
56	.2164	.1800	.1688	.1636	.1613	.1592
55	.1806	.1500	.1408	.1363	.1338	.1322
54	.1447	.1200	.1125	.1090	.1070	.1057

END OF SECTION

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. List of materials for Work of this Section.

B. Shop Drawings of forms and test pour details at least 15 calendar days before the test.

1. Proposed number, location and details of contraction, control, expansion and construction joints at least 15 days prior to concrete placement.

C. Catalog Cuts, Material Certification and Test Results

1. At least 35 calendar days prior to concrete placement, the following:

a. Name and address of proposed concrete supplier, type of plant, documentation of State Certification for plant and ready mix trucks, AASHTO Accreditation certification for the independent testing laboratory and certification for an on-site individual in a supervisory capacity from one of the programs specified in 3.03 A.

b. Material certifications, source, brand name and test results (where required) of cement, fine and coarse aggregate, fly ash, slag, silica fume, metakaolin and concrete admixtures following guidelines of Appendix "B". In addition, arrange for an independent testing laboratory to verify that Very High Early Strength Cement meets compressive strength, absolute drying shrinkage and setting time requirements specified in 2.02 B at the testing frequency specified therein.

c. Brand names and chemical compositions of form oil or release agents, evaporation retardant and liquid membrane curing compounds. For Architectural Concrete include this information also for forms, form liners and pigments.

d. Certification of compatibility and five-year performance record for liquid membrane forming curing compound, when used under conditions specified in 3.04 C, and the requirements of 2.02 R.2.

e. Test data and field use history for corrosion inhibitor admixtures (when specified on the Contract Drawings) as per 2.02 O.4:

(1) Manufacturer's test method to determine the concentration of the active component of the inhibitor.

(2) Procedures for the production of concrete mixes containing a corrosion inhibitor for the range of concrete temperatures from 50 deg F to 90 deg F and a procedure for the placement of concrete when a retarder is being used.

f. Certification that admixtures conform to the requirements of 2.02 M submitted with Appendix "B" "Concrete Materials and Mix Proportion Data". Include dosing and re-dosing charts, which shall demonstrate the effects of concrete temperatures from 50 deg F and 90 deg F.

g. A chemical analysis report of the percent by weight of silica fume solids by an approved independent testing laboratory when a wet slurry type of silica fume is being used.

h. Source of expansion and/or contraction joints.

i. Type, number and method of application of concrete vibrators.

D. Samples

1. Concrete ingredients for trial batches including cement, stone, sand, fly ash, slag, silica fume, metakaolin, admixtures, corrosion inhibitor, fibers, latex, pigment and anti-washout agent. Furnish these to the Engineer in whatever quantities he may require at least 35 days prior to concrete placement. This applies to all mixes, including changes to an approved mix.

2. At the request of the Engineer, submit cement, fly ash, slag and/or silica fume samples to check the Mill Certification at any time in accordance with 3.05 C.

3. For architectural concrete, provide two (2) sample panels (12" x 12" x 2" minimum size) for each mix for approval of color and texture. Provide catalog cuts for forms, form liners and form oil or release agents.

E. Construction Procedures and Quality Control Documents and Plans

1. At least 35 calendar days prior to concrete placement, the following:

a. Contractor's Quality Control Plan in accordance with 1.04 B.

b. *Precast concrete fabricator's planned schedule for all production and a Quality* Control Plan a minimum of 15 days prior to the commencement of production.

c. Cold and Hot Weather Concreting Plans in accordance with 1.03 of the Specification. Materials and methods for protecting concrete from freezing.

d. Pumping Procedure Plan, including, at a minimum, the pumping scheme, pump description, line diameter, line length and the number of turns and line offsets.

e. Written placement procedures that are in conformance with ACI 304R, Chapter 8 if concrete is being placed underwater.

f. Method of adding concrete admixtures, high range water reducers, non chloride accelerators, corrosion inhibitors, anti-washout agent, latex, fibers, pigment, slag, fly ash and silica fume.

g. Mixing and placement procedures and methods, as well as catalog cuts of equipment for installation. For hand mixes, submit the methods of proportioning, mixing (including minimum time requirements), transferring and placing the concrete.

h. Method of concrete placement in pipe piles (including elephant trunk size, length and material type).

i. Method of concrete placement and consolidation adjacent to joint assemblies and embedded hardware.

j. Curing Procedure Plan in accordance with 3.04, including the method and materials for curing.

k. Control Joint Location Plan.

l. Materials and procedures for filling cracks and patching honeycombs and/or spalls.

m. Pumping of LWC: Perform a test pour prior to the actual construction. Submit the details of the lightweight concrete test pour to the Engineer for approval. Base the test on the height and length of the proposed pumped delivery.

2. Daily copy of batch records in accordance with 1.04 A.1.a.

F. Concrete Mix Proportions

1. Appendix "B" "Concrete Materials and Mix Proportion Data" at least 35 calendar days prior to concrete placement in accordance with 2.03 A of the Specification. To substantiate the mix proportions, submit all data and field results in accordance with 2.03 A.
2. ACI Grade I certification for all personnel performing concrete testing.
3. Written request to the Engineer for approval if a change in the weights of fine and coarse aggregate and cement is required in the approved mix proportions.

G. For Information Only

1. Pre-concrete construction meeting agenda a minimum of 15 days prior to the scheduled date of the meeting.
2. Minutes of the pre-concrete construction meeting within 5 days of the meeting.

H. Design Computations

1. If required by the Engineer or noted on the Contract Drawings, have design computations signed and sealed by the Professional Engineer licensed in the state where Work is being done.

END OF APPENDIX "A"

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

APPENDIX "B"

CONCRETE MATERIALS AND MIX PROPORTION DATA

A. Materials:

1. Cement: Type.....Source/Brand.....
2. Sand: Fineness Modulus.....Source.....
3. Stone: Size.....Class.....Source.....
4. Fly Ash: Type.....Source.....
5. Slag: Grade.....Source.....
6. Microsilica (Silica Fume): Source/Brand.....
7. Metakaolin: Source/Brand.....
8. Admixtures (Source/Brand):

   Air Entraining Agent.....

   Non-Chloride Accelerator.....

   Retarder.....

   Water Reducer.....

   Water Reducer - Retarder.....

   High Range Water Reducer.....

   High Range Water Reducer - Retarder.....

   Polycarboxylate High Range Water Reducer

   Anti-Washout Admixture.....

   Corrosion Inhibitor.....

   Latex.....

   Pigment.....

B. Mix Proportions

1. Proposed method of placement:.....Tremie/Mobile .....Mixer/Transit Mixer/Portable Mixer/ Pumping/Tube Diameter:.....
2. Proportion of Ingredients:

   Cement.....lbs./cu. yd.

   Fly Ash.....lbs./cu. yd.

   Slag.....lbs./cu. yd.

   Silica Fume.....lbs./cu. yd.

Metakaolin.....lbs./cu. yd.

Pigment.....lbs./cu. yd.

Stone.....lbs./cu. yd.

Sand.....lbs./cu. yd.

Water.....lbs./cu. yd.....gallons

Air Entraining Agent:.....ounces/cu. yd.

Admixtures (specify type and amount):

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

3. Mix Properties:

Compressive Strength: f'c =.....psi at.....days/hours

Flexural Strength:.....psi at.....days/hours

Permeability at 28 days:.....Coulombs

Slump:.....inches

Water to Cementitious Ratio:.....

Air Entrainment:.....%

Sand/Stone Ratio:

Combined aggregate gradation chart (% retained on each sieve).

Unit Weight:.....lbs./cu. ft.

C. Conformance with ACI 318

Attach a report on mix proportion and test/statistical data documenting conformance with ACI 318, Chapter 5, or ACI 304R, Chapter 8, as they apply to the Work of the Contract.

D. Concrete Supplier/Batch Plant

1. Name:.....
2. Address:.....
3. Contact Name:.....
4. Telephone number/Fax number/E-mail address:.....
5. Quality Control technician(s):.....

Name(s):.....

Telephone number(s):.....

END OF APPENDIX "B"

DIVISION 3

SECTION 03361

SHOTCRETE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for pneumatically-applied concrete (shotcrete).

B. Related Work specified in other Sections of the Specifications includes the following:

1.	Abrasive Blasting Of Pavements	Section 02574
2.	Concrete Reinforcement	Section 03200
3.	Concrete Spall Repairs	Section 03730

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Concrete Institute (ACI)

ACI 308.1-11	Specification for Curing Concrete
ACI 548.11R-12	Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
ACI 506R-05	Guide to Shotcrete
ACI 506.2-95	Specification for Materials, Proportioning, and Application of Shotcrete

American Society for Testing and Materials International (ASTM)

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C1140	Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
ASTM C1141	Standard Specification for Admixtures for Shotcrete

ASTM C1202	Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
ASTM C1587	Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull off Method) (Withdrawn 2013)
	Steel Structures Painting Council (SSPC)
SSPC-SP 6/ NACE No. 3	Commercial Blast Cleaning

1.03 PERFORMANCE AND ENVIRONMENTAL REQUIREMENTS

A. All Work of this Section shall be performed in accordance with the recommendations of ACI 506R-05 unless otherwise specified herein or otherwise shown on the Contract Drawings.

B. At least forty five (45) days prior to the initial application of shotcrete, preconstruction test panels shall be prepared and furnished to the Engineer for examination and testing in the following manner. Contractor shall transport test panel to the Materials Engineering Unit at 241 Erie Street, Jersey City, New Jersey.

1. A minimum of one test panel shall be prepared by each application crew using the equipment, materials and mix proportions approved by the Engineer for use in this Contract. Additional test panels shall be prepared so that there is one for each proposed mix design and for each shooting position to be encountered on the job (i.e., horizontal, vertical, overhead sections, etc.).
2. All test panels shall be filled with shotcrete in the presence of the Engineer. Panels are to be shot by American Concrete Institute (ACI) Certified nozzlemen who will actually be performing Contract work. Cure panel with the same method to be employed on-site project. Panels will be examined for evidence of voids, sand pockets and bond between successive layers. Additionally cores will be drilled and tested for conformance with Section 1.04.
3. Each preconstruction test panel shall be at least 30" X 30" X 4". Provide the same backing, finish and reinforcement as in the work of this section.
4. Once the test panels have been approved the Contractor shall perform shotcreting with the same methods, equipment, mixes, and crews (including nozzle men) as used in the preconstruction tests.

C. The Contractor shall verify the thickness of application throughout and furnish records of his measurements to the Engineer.

D. Furnish all labor, materials and equipment required to assist the Engineer in performing inspection and testing. Make scaffolding and other equipment available as necessary to permit access to all portions of the installation.

E. Do not place shotcrete on any surface that is unsound, not clean, frozen or where there is standing water present.

F. No shotcrete shall be placed on surfaces when the concrete substrate surface temperature is below 50°F.

G. No shotcrete shall be placed when the ambient temperature may fall below 40°F within 72 hours.

H. If necessary, provide adequate protection as approved by the Engineer to maintain 40°F to assure that a compressive strength of 500 psi is attained in place prior to exposure to one cycle of freeze thaw and that 75% of the 28-day f'_c is obtained before multiple cycles of freeze thaw are anticipated.

I. Except as otherwise permitted below, shotcrete shall not be placed in weather conditions which may result in rapid drying or stiffening unless procedures have been submitted and approved by the Engineer. Procedures in ACI 506R-05 shall be followed to define conditions leading to rapid drying and procedures to prevent rapid drying of shotcrete.

J. Where any of the above conditions prevail, mixing and placing may be permitted by the Engineer with special precautions to ensure obtaining results at least equal to those which would be obtained in the absence of such adverse conditions.

1.04 QUALITY ASSURANCE

A. The entity performing the Work of this Section shall have successfully completed at least two projects involving quantities and complexities similar to those required under this Section.

B. The Contractor shall make one production test panel per 10 cubic yards or portion thereof placed, per shift, per crew, minimum one panel per crew day with dimensions of 18"X18"X4" gunned in the same position as the Work represented. All panels shall be prepared in the presence of the Engineer. Panels shall be gunned during the course of the work by the Contractor's regular ACI certified nozzleman. After fabrication, test panels shall be covered and sealed to prevent moisture loss in the same manner as work represented. Label panels with date shot, contract no. and any other pertinent data. Transport these panels to the Materials Engineering Unit at 241 Erie Street, Jersey City, NJ for testing.

C. Cores shall be obtained and prepared in accordance with ASTM C 42 to establish the 28-day compressive strength.

D. In-situ bond strength testing for overhead and vertical applications shall be performed by the Contractor. A minimum bond strength of 125 psi in 28 days will be required. Testing will be performed in accordance with ACI 503.6a-97 and ASTM C1583. The ASTM C1583 (withdrawn 2013) test procedures shall be approved by the Engineer. A minimum of three bond strength tests shall be done for every 10 cubic yards or portion thereof placed, per shift, per crew, minimum one panel per crew day. The Engineer will inspect the areas prepared for application of shotcrete. Any deficiencies shall be rectified by the Contractor as directed by the Engineer.

E. All materials, mixes, applications and applied thicknesses will be verified by the Engineer.

F. The Engineer will inspect the completed works by sounding 7 days after shotcrete application.

G. Based on the results of this testing, the areas in the permanent construction determined to be defective shall be removed and replaced by the Contractor at no additional cost to the Authority.

H. Acceptance criteria for quality assurance testing shall be in accordance with ACI 506.2-95.

I. Employ ACI certified nozzlemen who have had previous experience in the application of the type(s) of shotcrete to be performed for this Contract on a least two projects of comparable nature or have them work under the immediate supervision of a foreman or instructor with at least five years of comparable experience. Each crew shall demonstrate, to the satisfaction of the Engineer, acceptable proficiency in uniformly applying shotcrete.

J. All equipment for the preparation, mixing, placing and finishing of the shotcrete shall be approved by the Engineer prior to the start of any work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Properly deliver and handle materials to prevent their contamination, segregation, or damage.

B. Store cement in weather-tight enclosures to protect against dampness and contamination.

C. Prevent segregation and contamination of aggregates by proper arrangement and use of stockpiles.

D. Store admixtures properly to prevent contamination, evaporation, freezing, or other damage.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Conform to all requirements of ACI 506.2-95except as modified herein.

B. Cement: ASTM C150, Type I or Type II.

C. Aggregate: Use normal weight aggregate conforming to ASTM C33, with the combined gradation of coarse and fine aggregates confirming to the gradations shown in table below. Aggregates shall be tested for reactivity with cement in accordance with ASTM C1260.The 0.1% 14-day expansion limit shall not be exceeded.

GRADATION LIMITS FOR COMBINED AGGREGATE			
Sieve Size U.S. Standard Square Mesh	Percent by weight passing individual sieves		
	Gradation No. 1	Gradation No. 2	Gradation No. 3
3/4 in.	--	--	100
1/2 in	--	100	80-95
3/8 in.	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

D. Reinforcing bars, anchors, fasteners, and welded wire mesh for shotcrete shall be as shown on the Contract Drawings.

E. Abrasive Blast Material shall be "Black Beauty" as manufactured by Reed Minerals, a Division of Harsco Corporation, South Kearny, NJ or approved equal.

F. Curing Materials Liquid Membrane shall comply with ASTM C309.

1. For exterior applications curing membranes are restricted to ASTM C309 Type 2, Class B materials. ASTM C309 Type 1D membranes are acceptable for other applications.
2. Curing membranes shall be wax free when used on concrete upon which overlays, coatings, paints, sealers or any topping is to be applied, or where vehicular, pedestrian or aircraft traffic will pass.
3. Membranes must be Volatile Organic Compound (V.O.C.) Compliant for both the States of New York and New Jersey. Certification of Compliance must be available upon request.
4. The membrane must restrict the loss of water to not more than 0.4 kilograms per square meter in 72 hours. Coverage rate must be specified by the manufacturer to meet this criteria.

G. Evaporation Retardant: The following products, or approved equals, shall be used.

1. "Euco Bar" manufactured by The Euclid Chemical Co.
2. "Confilm" manufactured by BASF Admixtures.
3. "E Con" manufactured by L & M Construction Chemicals, Inc.

H. Water: Mixing water shall be fresh, clean potable water.

I. Air Supply: Furnish clean air, not contaminated with oil or other deleterious substances.

J. Admixtures: Admixtures shall be subject to approval by the Engineer and shall be in accordance with the following standards:

ASTM C260 Standard Specification for Air Entraining Admixtures for Concrete.

ASTM C494 Standard Specification for Chemical Admixtures for Concrete.

ASTM C1141 Standard Specification for Admixtures for Shotcrete.

K. Fasteners: Anchors and fasteners shall be as shown on the Contract Drawings.

2.02 MIXES

A. Conform to all requirements of ACI 506.2 95 except as modified herein.

B. Dry Mix Shotcrete

1. Compressive Strength: 4500 psi minimum at 28 days unless otherwise specified on the Contract Drawings.
2. Cement/Aggregate Proportions not to exceed 1:3.
3. Water/Cement ratio maximum not to exceed 0.35.
4. Permeability: less than 1000 coulombs measured in accordance with ASTM C1202,
5. Accelerators: Non-chloride type may be used if approved by the Engineer.

C. Wet Mix Shotcrete

1. If wet mix shotcrete is transit mixed (truck supplied) it shall conform to provisions of ASTM C94.

2. If wet mix shotcrete is volume batched and mixed on site it shall conform to provisions of ASTM C685.
3. Compressive Strength: 4500 psi minimum at 28 days unless otherwise specified on the Contract Drawings.
4. Admixtures: Conform to ASTM C494 and ASTM C1141.
5. Air Entrainment: Conforms to ASTM C260. 5% to 8% of air entrainment shall be added to the mixture in accordance with manufacturer's recommendation.
6. Slump 1.5" to 3" as controlled by Section 3.02 G of this Specification. The use of high range water reducer will be acceptable to modify the slump upon approval by the Engineer.
7. Air: 5% to 8% at the point of discharge based on test performed in accordance with ASTM C231.
8. Water cement ratio: 0.35 maximum.
9. Rapid Chloride Permeability: less than 1000 coulombs measured in accordance with ASTM C1202.
10. Accelerators: Non-chloride type may be used as approved by the Engineer.

PART 3. EXECUTION

3.01 PREPARATION

A. The type and extent of deteriorated or delaminated concrete to be repaired shall be as shown on the Contract Drawings or as determined by the Engineer. Repairs shall be made in accordance with Specification Section 03730 and the details shown on the Contract Documents.

B. The Contractor shall square off the concrete area to be repaired with a 1 inch deep sawcut and shall remove all loose, deteriorated and delaminated concrete by means of pneumatic or mechanical chipping tools.

C. Removal of loose, deteriorated and delaminated concrete, efflorescence and encrustation on concrete surfaces by means of pneumatic or mechanical chipping tools shall be done as follows:

1. Pneumatic hammers heavier than nominal 30 pound class shall not be used.
2. Pneumatic hammers or mechanical chipping tools shall be operated at an angle not to exceed 45 degrees relative to the surface of the area being repaired.
3. The Contractor shall remove deteriorated concrete to a sound surface (no visible evidence of fractured aggregate) for a depth not less than 1/4 inch or more than 3/4 inch beyond the deteriorated layer of concrete.
4. All concrete surfaces to be repaired, shall be cleaned of dirt, dust, laitance and other contaminants by abrasive blasting in accordance with Specification Section 02574 followed by water blasting (5000 psi pressure) and low-pressure oil-free air drying to yield a dry and sound concrete surface. Such work shall be performed within the same work period that the installation of the shotcrete material takes place, or as otherwise approved by the Engineer.

D. The Contractor shall not use power tools to remove concrete adhered to exposed reinforcing steel. Removal of concrete, rust and/or corrosion adhered to exposed rebars shall be performed by abrasive blasting to a SSPC-SP6/NACE No. 3 surface finish.

E. The Contractor shall not damage or de-bond reinforcing steel, or shatter concrete beyond the area to be repaired.

F. Corroded reinforcing bars that exhibit 25% loss of original cross section area or more after cleaning, shall be repaired in accordance with Specification Section 03730. Payment for such work shall be at the Net Cost thereof.

3.02 APPLICATION

A. Conform to all requirements of ACI 506.2-95 except as modified herein.

B. Deposit shotcrete only after the surface preparation is approved by the Engineer.

C. Uniformly wet down and remove any standing water from the surface against which shotcrete is to be placed before depositing shotcrete.

D. Deposit shotcrete only in the presence of and by methods approved by the Engineer.

E. In depositing the shotcrete, the nozzle of the gun shall be held in a position as near as possible at right angles to the surface against which the shotcrete is to be placed. Follow the techniques for placement specified in ACI 506.2-95.

F. The shotcrete should flow from the nozzle in a steady uninterrupted flow. If the flow becomes intermittent, it should be directed away from the work area until it becomes steady again.

G. Thickness of layers to be applied will be determined by the material's ability to withstand sagging. Any areas exhibiting sagging or sloughing shall be carefully removed and replaced without disturbing the adjacent material.

H. Where succeeding layers are to be placed, and the first layer has reached its initial set, any laitance or rebound should be removed by brooming or low pressure oil-free air. Any laitance or rebound that cannot be removed by brooming or low pressure air shall be removed by sand blasting, followed by low-pressure air water washing. Prior to placing succeeding layers, the underlying layer shall be thoroughly wetted.

I. Rebound shall not be worked back into the repair area by the nozzleman. Rebound not falling clear of the construction area should be removed.

J. Rebound shall not be salvaged and reused for the Work of this Section.

K. If deposits of sand occur in any coat, they shall be thoroughly removed and replaced with new shotcrete.

L. Reinforcing bars, welded wire fabric, fasteners, and anchoring devices shall be as shown on the Contract Drawings and approved by the Engineer.

M. Unless otherwise shown on the Contract Drawings, a minimum of 1 inch of shotcrete cover shall be installed over all reinforcing bars.

N. If more than four hours have elapsed since the preceding coat was placed, use abrasive blasting to remove the air dried surface and promote bond for the successive coat.

O. Provide a finish as indicated in the Contract Drawings.

P. When a finish is shown on the Contract Drawings that calls for screeding, screed the surface approximately three hours after the shotcrete has been placed, but under no circumstances while the material is soft enough to slough, pull or crack from the application of the screed edge.

Q. Construction joints will not be permitted except where shown on the Contract Drawings or as determined by the Engineer. Every effort should be made to apply the full layer at an individual location prior to ceasing work at that location. In the event that a construction joint is required, it shall be formed by tapering the material to a one (1) inch formed edge. Any joint thus formed shall be thoroughly cleaned and wetted prior to applying shotcrete adjacent to it.

R. All corners shall be formed true to match existing lines unless otherwise shown on the Contract Drawings.

3.03 ADJUSTMENTS

A. Touch up and restore finished surfaces where damaged by shotcreting.

B. Remove spilled, splashed or splattered shotcrete from all surfaces. Do not mar surface finish of item being cleaned.

C. Remove and replace all shotcrete as directed by the Engineer, which lacks uniformity, or exhibits segregation, honeycombing or delamination, or which contains dry patches, slugs, voids, or sand pockets (lack of adequate bond or low compressive strength).

3.04 CURING AND PROTECTION

A. Shotcrete shall be cured using either an approved curing membrane. The effectiveness of curing shall be determined from strength tests performed on core samples taken from test panel shot and cured in the same manner as the production shotcrete.

B. Careful attention shall be given to protect all shotcrete from the elements, freezing, flowing water and from defacement of any nature during construction operations. Immediately after placing or finishing, protect shotcrete from loss of moisture, using one of the curing methods listed below.

C. If evaporation rates defined in ACI 308 Figure 4.1 exceed 0.2 lb/ft^2/hr, a fog spray or evaporation retarder shall be applied immediately after the placement of concrete. Fog spray should be maintained until curing operation commences.

D. Membrane Curing: Liquid membrane, if permitted, shall be applied by approved pressure spraying or distributing equipment in two uniform full applications perpendicular to each other as recommended by the manufacturer. Each application shall be the full quantity recommended by the manufacturer. Manufacturer's recommendations for agitation during application and warming where necessary during cold weather shall be followed. *The Engineer will check for uniformity through random sampling and testing.* Testing may include determination of membrane infrared spectrum, ph value, specific gravity and solid content.

END OF SECTION

SECTION 03361

SHOTCRETE

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts, Material Certification and Test Results

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
2. Submit to the Chief of Materials Engineering, Material Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310 1397, with a copy to the Engineer the proposed shotcrete mix design and test data as required by ACI 506R-05.
3. Submit to the Chief of Materials Engineering, a certification of source of raw materials and certificates of analysis for all cement to be used.
4. Submit to the Chief of Materials Engineering, the manufacturer's certification of spray on curing compound, sheet materials or any other materials or methods intended for curing.
5. Submit documents indicating experience of entity performing the work in previous projects involving similar types of work in quantity and complexity.
6. Submit documents indicating qualification and certifications required for the nozzlemen in accordance with paragraph outlined in Section 1.04.
7. Submit a list of equipment to be used in performing required tasks as outlined in Section 1.04.

B. Samples

1. Submit notification of preconstruction test panel application 48 hours in advance and deliver test panel(s) for examination, testing and approval in accordance with Section 1.03 herein.
2. Deliver production test panels for testing in accordance with Section 1.04 B.

C. Construction Procedures and Quality Assurance Documents

1. Submit to the Chief of Materials Engineering acceptance criteria for Quality Assurance Testing outlined in Section 1.04 I.
2. Submit detailed procedures for the curing of shotcrete.
3. Submit special precautions to compensate for adverse environmental conditions as per Section 1.03.

END OF APPENDIX "A"

DIVISION 3

SECTION 03432

PRECAST SEGMENTAL CONCRETE BRIDGES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the fabrication, storage, transport and erection of precast structural concrete superstructure and substructure segments on a prepared foundation, to the established lines and grades, in accordance with the design, dimensions and details shown on the Contract Drawings and in accordance with this Section.

B. Related Work specified in other Sections of the Specifications includes the following:

1.	Epoxy Jointing of Precast Segments	Section 03052
2.	Concrete Formwork	Section 31000
3.	Concrete Reinforcement	Section 03200
4.	Post-Tensioning	Section 03250
5.	Portland Cement Concrete, Long Form	Section 03301
6.	Expansion Joints	Section 05830
7.	Disc Bearings	Section 13086

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM International)

ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

CEB - Comité Euro-International du Béton and
FIP - Fédération Internationale de la Précontrainte

1978 edition	CEB-FIP Model Code for Concrete

1.03 DEFINITIONS

A. Segment: A modular section of the superstructure and/or substructure consisting of a certain cross-section shape and length as detailed on the Contract Drawings.

B. Match Cast: A precast concrete fabrication process whereby a segment is cast against the preceding segment producing a matching interface which permits the re-establishment of the cast geometry at erection time. Match casting is accomplished by either the short line or long line casting method.

C. Short Line Casting: Casting segments one at a time in a casting cell between a bulkhead at one end and a previously cast segment at the other. The first segment is cast between the bulkhead and another, temporary bulkhead.

D. Long Line Casting: Casting segments on a casting bed of sufficient length to permit the cumulative casting of segments for the entire length of a span or cantilever between field closure pours without repositioning the segments on the casting bed. With this method, the first segment is cast between bulkheads and successive segments are cast between a movable bulkhead on one end and the previously cast segment on the other.

E. Casting Cell: A special formwork arrangement usually consisting of a fixed vertical bulkhead of the cross section shape at one end and adjustable soffit, side and core forms all designed and assembled into a machine for making a single superstructure segment. A casting cell for a substructure pier shaft segment consists of exterior and interior side forms and a soffit form of the cross section shape.

F. Balanced Cantilever (Erection): The segments are sequentially erected alternately on either side of the pier in cantilever to a point where a closure is cast-in-place.

G. Casting Curve: The curve of casting geometry that has to be followed in the casting cell or bed for achieving the theoretical bridge profile and alignment after all the final structural and time dependent (creep and shrinkage) deformations have taken place. The casting curve is a combination of the theoretical bridge geometrical profile grade, alignment and the camber.

H. Camber: The amount by which the concrete profile at casting time must differ from the theoretical geometric profile grade to compensate for all structural dead load, post-tensioning, all long term and time dependent deformations (creep and shrinkage) including all the intermediate erection stages and effects. (The opposite of deflections).

I. Erection Elevation: The elevation at which a segment is set in the structure at the time it is erected. (This is profile grade corrected by the amount of deflection calculated to occur from that stage onwards.)

J. Specialty Engineer: A Professional Engineer registered in the States of New Jersey and New York, other than the Engineer of Record or his subcontracted consultant, who undertakes the design and drawing preparation of components, systems, or installation methods and equipment for specific temporary portions of the project work or for special items of the permanent works not fully detailed in the plans and required to be furnished by the Contractor.

1. The Specialty Engineer may also provide designs and details for items of the permanent work declared by the Authority to be "minor" or "non-structural".
2. The Specialty Engineer may be an employee or officer of the Contractor or a fabricator, an employee or officer of an entity providing components to a fabricator, or an independent consultant.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Observe the temperature constraints specified in the Sections noted for the following operations:

1.	Casting Concrete:	Section 03301 (substructure)
		Section 03371 (superstructure)
2.	Epoxy Jointing of Segments:	Section 03052
3.	Grouting of Tendons:	Section 03250

1.05 QUALITY ASSURANCE

A. Design & Geometry Calculations: Appendix "A"

B. Fabricator Qualifications: Fabricate precast segments under the direction of an individual with a minimum of ten years experience fabricating precast, match cast segments for balanced cantilever construction.

C. Installer Qualifications: Erect precast segments under the direct supervision of an individual with a minimum of ten years experience erecting precast, match cast segments for balanced cantilever construction by means of a self-launching overhead gantry.

D. Post-Tensioning Qualifications: Section 03250

E. Grouting Qualifications: Section 03250

F. Engineer Qualifications: The Contractor's Specialty Engineer shall have a minimum of ten years of experience in the specific type of structure for which he or she will be providing services.

G. Field Measurements: The geometry control surveyor shall have a minimum of five years experience in geometry control surveying for the casting of precast, match cast segments. The same experience level is required for the surveyor responsible for the geometry control surveying during erection.

H. Pre-Installation Conference

1. Pre-Concrete Construction: Section 03301
2. Pre-Substructure Segment Erection
   a. Conduct a pre-substructure segment erection meeting at the construction site by the Engineer a minimum of 20 days prior to the erection of the first precast substructure segment to review the Contractor's procedures for transport, alignment of base segments, segment erection, epoxy jointing, geometry control, tendon installation, stressing operations, and grouting operations.
   b. Notify the Engineer and send an agenda to all attendees a minimum of 15 days prior to the scheduled date of the meeting indicating review subjects. At no additional cost to the Authority make arrangements for the Contractor's superintendent and a qualified representative from each segment of the erection operation to be present, including, but not limited to the following:
      (1) Erection foreman
      (2) Stressing foreman
      (3) Grouting foreman
      (4) Surveyor
      (5) Post-tensioning supplier
      (6) Epoxy supplier
      (7) Contractor's Engineer
      (8) The Engineer.
   c. Record, type, and print meeting minutes and distribute them to all attendees of the meeting within 5 days of the date of the meeting.
   d. Do not schedule the pre-Erection meeting until all of the following have been submitted and approved, as applicable to the Work of the Contract:
      (1) Erection Manual: Substructure

(2) Grouting Plan for substructure

(3) Geometry Control Plan for substructure

(4) Crane Load/radius curves

(5) Crane location plans including segment supply

(6) Post-tensioning shop drawings for substructure

3. Pre-Superstructure Segment Erection

a. Conduct a pre-superstructure segment erection meeting at the construction site by the Engineer a minimum of 20 days prior to the erection of the first precast superstructure segment to review the Contractor's procedures for transport, erection of segments, epoxy jointing, geometry control, tendon installation and stressing operations, grouting operations and cantilever closure pours/stressing.

b. Notify the Engineer and send an agenda to all attendees a minimum of 15 days prior to the scheduled date of the meeting indicating review subjects. At no additional cost to the Authority make arrangements for the Contractor's superintendent and a qualified representative from each segment of the erection operation to be present, including, but not limited to the following:

(1) Erection foreman

(2) Gantry foreman

(3) Stressing foreman

(4) Grouting foreman

(5) Surveyor

(6) Post-tensioning supplier

(7) Epoxy supplier

(8) Contractor's Engineer

(9) The Engineer.

c. Record, type, and print meeting minutes and distribute them to all attendees of the meeting within 5 days of the date of the meeting.

d. Do not schedule the pre-Erection meeting until all of the following have been submitted and approved, as applicable to the Work of the Contract:

(1) Erection Manual: Superstructure including:

(a.) Transport routes for segment supply with any local permits required for segment transport.

(b.) Cantilever Closure Sequence

(c.) Cantilever construction at expansion joints

(d.) Pier Table/Cantilever Stabilization Plan

(e.) Gantry Assembly Plan

(f.) Gantry Lateral Shift Plan (NB structure to SB structure)

(g.) Back launching plan from tower structure to abutment

(2) Grouting Plan for superstructure

(3) Geometry Control Plan for superstructure including:

(a.) Geometry adjustment plan to correct for deviations

(4) Crane load/radius curves (if used)

(5) Crane location plans including segment supply (if used)

(6) Post-tensioning shop drawings for superstructure

1.06 PRECAST SEGMENT HANDLING, STORAGE AND SHIPMENT

A. Handle segments with care to prevent damage. Handle segments using only the devices shown on the shop drawings for this purpose. Store all precast segments level in the upright position. Firmly support all precast segments for storage and shipment on a three point bearing system, subject to the approval of the Engineer, which does not introduce a twist under self weight. Do not stack segments one upon another unless approved by the Engineer.

B. Prior to shipment, the Engineer will thoroughly inspect each segment for damage. Thoroughly clean the faces of all joints of laitance, bond breaking compound and any other foreign material by light sand blasting prior to shipment.

1. Make no repairs of minor spalls or chipped areas on the joint surfaces until after erection of the segment. See Section 3.01.I.3.
2. Upon arrival at the bridge site, the Engineer will inspect each segment again. If in the Engineer's opinion, any damage has occurred during shipment that will impair the function of the segment (structurally, aesthetically, etc.), the segment will be rejected.
3. Replace any rejected segment with an approved segment at no cost to the Authority.
4. Provide firm support at bearing locations noted above.
5. Fully secure the segments against shifting during transport.
6. Provide a storage area of suitable stability for the segments to prevent differential settlement of the segment supports during the entire period of storage.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Concrete: Use concrete as specified in Sections 03301 and 03371 except as specifically modified herein. Use No. 67 coarse aggregate in the concrete for segments.

B. Reinforcing Steel: Meet the requirements of Section 03200 for mild, epoxy-coated and stainless steel reinforcing steel as designated on the Contract Drawings.

1. Field welding of reinforcing steel is not allowed.

C. Post-Tensioning Systems: Use post-tensioning hardware components meeting the requirements of Section 03250. Components are not interchangeable and must comply with the details of the approved shop drawings.

2.02 FORMS

A. The Contractor is responsible for the design and engineering of the forms as well as their construction. Form all exposed formed surfaces of each element of the structure with the same material to produce similar concrete surface textures, color, and appearance. Obtain the Engineer's approval of forms prior to initiating casting operations. Build the details shown on the Contract Drawings or as amended by approved Shop Drawings into the forms.

B. Repair worn, damaged, or otherwise unacceptable forms and obtain the Engineer's approval before casting any segment.

C. Where sections of forms are joined, ensure that offsets in flat surfaces do not exceed 1/16 inch and that offsets with corners and bends do not exceed 1/8 inch.

D. Ensure that all joints in the forms and contact points with bulkheads and existing segments have good fitting seals to prevent loss of fine material and cement grout.

E. Check and inspect forms on a regular weekly basis to ensure proper alignment and geometric accuracy. Do not use forms which fail to meet the specified casting tolerances until such corrections are made to produce segments within the specified tolerances.

F. Use a small blockout at all locations where an external tendon enters or exits the face of the concrete at deviation blocks and diaphragms except at anchorage locations. The blockout will be approximately 2 inches larger in diameter or overall dimensions than the tendon duct and have a depth equal to at least the minimum prescribed concrete cover dimension shown in the Contract Drawings.

PART 3. EXECUTION

3.01 CASTING

A. Geometry Control: Do not begin casting without the Engineer's approval of the geometry control method (See Appendix A).

1. In the precasting yard, use instruments for the geometry control which are mounted on a permanent platform of sufficient height to sight on all control points. In addition, establish and maintain permanent benchmarks and reference points throughout the casting operations.
2. During casting, make all corrections required in the geometry of the segments from the control points established on each segment.
3. For match cast segments, after casting and before bond breaking to separate the segments, check the position of the new cast and match cast segments again. If positions are not as desired, make corrections in the next segment. In general, and unless otherwise approved by the Engineer, make observations on the geometry control reference hardware cast into the segments (i.e. elevation bolts, alignment offsets and lengths) to a precision of ±0.001 foot.
4. During casting operations, produce and maintain on a daily basis a graphical plot of the vertical and horizontal "as cast" alignments along each vertical and horizontal control line to an exaggerated scale in order to clearly highlight variations. Depict these against both the theoretical geometric vertical and horizontal alignment casting curves on a continuous layout of an entire unit of the bridge between expansion joints. Maintain this plot in good condition so that it may be used and referenced during erection.
5. Keep all geometry control hardware cast into any segments, such as elevation bolts and alignment hairpins, in place during erection for reference and checking purposes. Remove the hardware after completion of erection of the unit in the bridge between expansion joints.
6. Use experienced personnel to operate the instruments and supervise the casting operation. Prior to the commencement of casting, obtain the Engineer's approval of the experience and/or qualifications of the supervisory and instrument operating personnel, particularly with regard to the observational precision required.

B. Embedded Items

1. General: Embedded items must be in accordance with specifications for post-tensioned construction and the requirements herein.

2. Embedded Post-Tensioning Ducts: Ensure that embedded ducts for post-tensioning tendons and bars are positioned accurately to their required alignment. Properly fabricate and identify all ducts so that proper positioning is assured and can be verified after casting.

   Utilize positive methods to ensure that ducts will not be displaced or damaged during concrete placement and consolidation. Adequately secure all embedded post-tensioning ducts to the reinforcement cage at intervals not exceeding 30 inches for steel pipes and 24 inches for plastic ducts, (Small ducts and very flexible ducts may require closer supports). Any auxiliary ties and support bars needed for these purposes will be considered incidental and at no extra cost to the project. Prevent the concrete cover requirements from being violated by any auxiliary ties and support bars.

   After installation in the forms, ensure that the ends of the ducts are sealed at all times to prevent entry of water, debris and fine material. Following each pour of concrete, demonstrate that all empty ducts are free of water and are unobstructed and undamaged.

   Immediately prior to installation of the prestressing steel, again demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and free of water and debris.

3. Anchor Plates and Castings: Prior to placing concrete in the forms, fix all tendon anchor plates and anchor castings in their respective position in the forms, connected to their duct and sealed to prevent mortar intrusion. Ensure that anchor plates and castings are rigidly fixed in the forms to maintain their correct alignment and position during concrete placement and consolidation.

4. Reinforcing Steel: Fabricate and place reinforcing steel in accordance with the Contract Drawings or as superseded by the Approved Shop Drawings and as required herein.

   a. Do not cut out or remove reinforcing steel to permit proper alignment of post-tensioning ducts. Replace any bar that cannot be fabricated to clear the ducts by additional bars with adequate lap lengths and submit the details to the Engineer for approval.

   b. In the plane of the reinforcement parallel to the nearest surface of the concrete, ensure that bars do not vary from plan placement by more than 1 inch, nor by more than one-eighth of the spacing between bars, whichever is less. In the direction perpendicular to this plane of reinforcement, ensure that bars do not vary from plan placement by more than 1/4 inch. The top and bottom cover of reinforcing steel must be within 1/4 inch of the cover dimensioned on the Contract Drawings. The edge cover of the reinforcing steel must be within 1 inch of the cover dimensioned on the Contract Drawings.

C. Casting Requirements

1. General: Ensure that all materials, details, and procedures are as specified herein, as noted on the Contract Drawings, or as directed by the Engineer.

2. Do not begin casting segments until the Engineer approves the relevant shop drawings, calculations, casting manuals, concrete forms and concreting operations and the post-tensioning system components and layout if different from that on the Contract Drawings.

   a. Approval of post-tensioning stressing elongations and forces for field erection operations is not required at this stage but is required prior to erection.

3. To use wet joints for corrective measures, obtain the Engineer's written approval.

4. Give each segment an erection mark indicating its location, orientation and order in the erection sequence, as well as the date on which the segment was cast. The erection mark shall be the segment designation as shown on the Contract Drawings, which includes the pier designation of the cantilever. Match mark abutting edges of adjacent segments using only the segment number and the up-station or down-station designation. Orientation shall be provided as an arrow that points in the direction of cantilever construction. Show erection marks on the segment shop drawings.

D. Preparation for Match Casting: When match casting is used, take great care in positioning of the match cast (previously cast) segment in relation to the segment to be cast. Ensure that the match cast segment is not twisted.

1. Ensure that all materials to be embedded in the concrete of the new cast segment are properly positioned and supported in order to maintain their position and withstand concrete placement and consolidation without damage. Make provisions for all projections, recesses, notches, openings, blockouts and the like in accordance with the Contract Drawings and approved shop drawings.

2. Cover the abutting surface of the match cast segment with a thin film of a bond breaker consisting of flax soap and talc, or other material approved by the Engineer. Use a soap and talc mixture consisting of five parts flax soap to one part talc. The Engineer will base acceptance of a material other than soap and talc prior to casting any segments by demonstration on a large specimen consisting of a precast piece and a new cast piece with a contact facial area of at least four square feet.

E. Concrete Placement, Consolidation and Finishing

1. Do not deposit concrete into the forms until the entire set-up of the forms, reinforcement, ducts, anchorages and embedded items have been thoroughly inspected and checked. Do not place concrete until the Engineer is satisfied that all the above items have been properly inspected and checked, and the rate of producing and placing the concrete will be sufficient to complete the casting and finishing operations within the scheduled time, that experienced concrete finishers are available where required for finish work and that all necessary finishing tools and equipment are on hand at the site of the work and are in satisfactory condition for use.

   During conveying and placement, protect concrete against undue drying or rise in temperature and inclement weather.

2. Concrete Placement Equipment: Use concrete placement equipment of a size and design which permits placing concrete within the specified time. Clean all equipment at the end of each operation or workday and, just prior to reuse, check the equipment again and clean off hardened concrete and foreign materials.

   Place concrete by belt conveyors or by pumping.

3. Concrete Placement Sequence

a. Superstructure Box Segments: First place concrete in the central portion of the bottom slab between the inside edges of the internal web forms, leaving a narrow gap of 6 to 12 inches for inspection of the bottom corners when the next load is placed in the webs. Then place the concrete in the bottom corners of each web to connect and consolidate with that already placed in the bottom slab. Then place concrete in the remainder of the webs in lifts not exceeding 24 inches at a time up to the top of the webs but not into the slab over the webs. Place concrete in the top slab in the outer wing and mid slab regions between webs before placing and completing zones over the top of the webs.

b. Substructure and Pier Shaft Segments: Cast segments vertically. Place the concrete in uniform lifts of approximately 24 to 36 inches and consolidate well.

c. Obtain the Engineer's approval on any alternative sequences to the above, or for any other precast components.

4. Concrete Placement and Consolidation – Superstructure Segments (SCC): Discharge individual loads of concrete into the forms, and place and consolidate in the required locations. After discharge into the forms, do not bodily move concrete from place to place within the forms by mechanical vibrators or other similar equipment.

a. Place concrete with care so that post-tensioning ducts, anchorages and any other embedded items are maintained in their proper positions and are not damaged.

b. No construction joints are allowed within a segment, except as detailed on the Contract Drawings.

c. Vibration of self-consolidating concrete is prohibited without the written consent of the Engineer.

5. Concrete Placement and Consolidation – Substructure Segments (Non-SCC): Discharge individual loads of concrete into the forms, and place and consolidate in the required locations. After discharge into the forms, do not bodily move concrete from place to place within the forms by mechanical vibrators or other similar equipment.

a. Place and consolidate concrete with care so that post-tensioning ducts, anchorages and any other embedded items are maintained in their proper positions and are not damaged.

b. Consolidate all concrete using approved vibrators together with any other equipment necessary to perform the work as specified. Use internal vibrators having a minimum frequency of 8,000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. Provide at least two stand-by vibrators in working condition for emergency use in case of malfunction.

c. Use external vibrators for consolidating concrete when the concrete is inaccessible for adequate consolidation by internal means. When external vibration is used, construct the forms sufficiently rigid to resist displacement or damage.

d. Vibrate concrete in a manner which avoids displacement or damage to reinforcement, post-tensioning ducts, anchorages and other embedded items.

e. No construction joints are allowed within a segment, except as detailed on the Contract Drawings.

6. Finishing

a. Strike off the roadway surface of the segment with an approved mechanical screed operated by a self contained power source.

b. Furnish and use a straightedge at least 24 inches longer than the segment while finishing the concrete deck surface of superstructure box girder segments. Use the straightedge approximately parallel to the centerline of the segment to strike an accurate surface between the bulkhead and the top of the match cast segment at all positions across the segment width.

c. Give the top surface of box pier segments a steel trowel finish at the precast site in accordance with Section 03301, subsection .3.03.H.2.d.

F. Curing

1. General: Where casting cells are intended to operate on a short (daily) cycle and it can be demonstrated to the satisfaction of the Engineer that the required initial concrete strengths for the removal of the forms, application of prestress, moving and handling of the segments and that the final concrete strength can be achieved in a timely and consistent manner, then steam curing will not be required. However, take precautions to promote proper curing by methods approved by the Engineer and in accordance with Section 03301. Such precautions must meet or exceed the following:

a. To prevent moisture loss, cover all exposed surfaces (those not in contact with a form or match cast segment) as soon as possible after casting with a moisture tight covering (wet curing blankets or other approved equal systems). Avoid spoiling the deck surface finish. Keep the cover on or within 12 inches of the deck surface.

b. Keep the moisture-tight covering substantially in place throughout succeeding operations such as geometry control survey, stripping of internal forms, wing forms and shifting of and working with a segment in a match cast position. Keep the concrete surface wet throughout these operations.

c. After stripping of the side and core forms, continue curing of the precast concrete by the application of a "Liquid Membrane Forming Curing Compound" as specified in Section 03301 to all exposed surfaces (including segment exterior once exposed by removal from the form). Apply an approved de-bonding compound to match cast surfaces to serve both as a bond breaker and seal for curing.

d. Maintain the moisture tight covering for at least 72 hours.

e. As an alternative, steam curing may be used.

f. While the new cast segment is in contact with the match cast segment, cover the match cast segment with curing blankets, or other approved equal system, to minimize the effects of differential temperature between the segments.

2. Steam Curing: Meet the requirements of Section 03301 modified by the following requirements when steam curing is used.

a. Provide a device or devices for simultaneously recording the temperature of three widely separated locations per casting cell. Locate the three temperature sensors near the top, middle and bottom of the enclosure or as otherwise approved by the Engineer. Identify the charts with the hours, dates and segment number and deliver to the Engineer immediately after steam curing is completed unless otherwise approved.

b. Apply an approved de-bonding compound to match cast surfaces to serve both as a bond breaker and seal for curing.

c. Expose match cast segments to the same curing environment (temperature and humidity) as the new cast segment until the new segment reaches the required strength to allow the removal of the forms.

G. Removal of Forms: Prior to removing the forms, protect the plastic concrete from adverse weather effects.

1. Keep supporting forms in place until the concrete has reached the required strength for form removal as specified on the Contract Drawings, in this Section, or as approved by the Engineer.

2. Test cylinders, made and cured in the same manner as the segment, to confirm the form release strength prior to removing form. With the Engineer's approval, a strength curve chart may be established to determine the time necessary for achieving the required form release strength, in accordance with the specifications for form removal.

3. Avoid cracking or damaging the segment when removing the forms, especially match cast surfaces and shear keys. Notify the Engineer of any damage which occurs and repair in an approved manner.

H. Age at Erection: Unless otherwise approved by the Engineer, precast components must be at least 28 days old prior to incorporating into the structure. The design is based on erection at an age of 90 days so any age less than 90 will require re-analysis by the Specialty Engineer. The Engineer may waive this re-analysis if in his sole opinion a proposed change of erection age will be of no significant consequence.

I. Tolerances:

1. General: The following tolerances apply to the fabrication of precast components:

a. Superstructure Box Segments:

Width of Web	±3/16 inch
Depth of bottom slab	±3/16 inch
Depth of top slab	±3/16 inch
Overall depth of segment	±1/4 inch
Overall width of segment	±3/8 inch
Length of segment	±3/8 inch
Diaphragm dimensions	±1/4 inch

b. Precast Box Pier Segments

Height (Individual Element)	±1/4 inch
Width and Breadth (Individual Element)	±1/4 inch
Thickness (wall)	±1/4 inch

c. All Fabricated Segments:

Ends (deviation from a plane per 20 ft width or depth
±1/4 inch per 20 feet not to exceed 1/2 inch.
Flat Surface (deviation from a plane at any location)
±0.025 in/ft not to exceed a total of 1/4 in.

2. Corrections: Control dimensions from segment to segment, including cast-in-place segments, and compensate for any deviations within a single segment or series of segments so that the overall dimensions of the completed structure meet the dimensions and overall erection tolerances shown on the Contract Drawings and allowed by this Section.

3. Repairs: Repair minor breakage, spalling, or honeycomb (not over 1 inch deep) by a

method approved by the Engineer. Major breakage, spalling, or honeycomb in excess of 1 inch deep is subject to the Engineer's structural review. If found to be satisfactory, repair these areas using a method approved by the Engineer.

a. Do not perform surface finishing or repairs on the matching joint surfaces of precast segments until after final erection of the segment, except as herein noted.

b. If more than 20%, but less than 40% of the total contact surface of all shear keys in any single web is broken, spalled or honeycombed, grind the damaged areas to produce a cylindrical depression into sound concrete to a depth and width approximately equal to the shear key dimensions. Complete necessary repairs to shear keys damaged at the casting site prior to shipping the segment to the erection site.

c. After erection of the segments adjacent to the damaged keys and prior to erection of additional segments, carefully pack the voids left by the depressions with an epoxy mortar as approved by the Engineer. With the Engineer's approval, an alternate method of repair may be used. The Engineer will consider the segment unsatisfactory for use if more than 40% of the total contact surface of all shear keys in any single web is broken, spalled or honeycombed.

d. Use an Engineer approved method for repairing damaged alignment keys located in the top and bottom slabs. The Engineer will consider a segment unsatisfactory for use if more than 50% of the total contact surface of all alignment keys in any element of the slab (wing overhang, central portion between webs, etc.) is broken, spalled or honeycombed.

e. Remove and dispose segments found to be unsatisfactory and not repairable after structural review and cast a new segment at no expense to the Authority.

3.02 ERECTION

A. Erection Manual: Do not start erection without the Engineer's approval of the erection manual referenced in Appendix A.

B. Erection Geometry Control

1. General: Numerical or graphical methods may be used for alignment control and checking during erection. Establish the key stages for checking of the erection in the erection manual and obtain the Engineer's review and approval. Key stages would include, for example, setting a pier segment during cantilever erection and various intermediate points during subsequent segment erection, at span closure and upon completion.

2. Prepare a table of elevations and alignments required at each key stage of erection in accordance with the Contract Drawings, as cast geometry, camber and erection elevations for establishing erection controls and submit to the Engineer for approval.

3. Carefully check elevations and alignments at each stage of erection and correct as required to avoid any possible accumulation of errors.

4. If geometric corrective measures are necessary, the Engineer will require the Specialty Engineer to develop the means and methods to ensure the epoxy joint remains watertight and free from localized stress concentrations. The Specialty Engineer will be required to submit the corrective measures to the Engineer for approval. Use shims made of ASTM A240 Type 304 wire cloth (roving) with a maximum of 1/8 inch thickness.

5. Balanced Cantilever Erection: Check the alignment and elevations of the cantilever(s), using two independent surveys, within one hour of sunrise on each day that segments are to be erected. Check the measurements made by each survey and ensure they agree to within 1/4 inch. When measurements do not agree, discontinue erection of segments until discrepancies in measurements are resolved to the satisfaction of the Engineer.

6. Accurate positioning of the pier segments is very important as it will establish the line and grade for cantilevers in each direction. Position each pier segment according to the final longitudinal alignment, grade and cross-slope and ensure no further erection continues until and unless these segments are properly located on the piers by the means provided. Keep the horizontal and vertical alignments of the pier segment within 1/16 inch of the alignment values required to control points as established by the approved erection plans.

7. Check at each key stage of erection, in accordance with approved erection procedures, the ends of cantilevers for required elevations and alignment. Correct any deviation from the required alignment by a method approved by the Engineer.

C. Erection Tolerances:

1. Ensure that maximum differential between outside faces of adjacent segments in the erected position does not exceed 3/16 inch.

2. Ensure that transversely, the angular deviation from the theoretical slope difference between two successive segment joints not exceed 0.001 rad.

3. Ensure that longitudinally, the angular deviation from the theoretical slope change between two successive segments does not exceed 0.003 rad.

4. Dimensions from segment to segment will compensate for any deviations within a single segment so that the overall dimensions of the completed structure meets the dimensions shown on the Contract Drawings such that the accumulated maximum error does not exceed 1/1000 of the span length for either vertical profile and/or horizontal alignment.

5. Carefully check elevations and alignments at each stage of erection and correct as required to avoid any possible accumulation of errors.

D. Other Erection Requirements

1. Closure Joints: Use concrete meeting the same specifications and criteria as the concrete in the segments except for compressive strength which is specified on the Contract Documents. Ensure that concrete reaches the minimum required strength as shown on the Contract Drawings or in the Specifications prior to stressing the continuity post-tensioning. Ensure that the closure joint forms provide tolerances as specified under Subsection 3.01.I.1.

   a. Formwork: Adequately support formwork at all closure joints to take all loads applied and do not remove them until the concrete in the joints has reached its required strength and the longitudinal tendons have been tensioned.

2. Balanced Cantilever Erection

   a. Deformations: For computing deformations due to time dependent stress variations, base the erection times on Contractor's CPM Schedule.

      (1) Compute deformations due to creep and shrinkage and the concrete modulus of elasticity using the CEB-FIP Model Code for Concrete, 1978 edition.

3. Temperature Restrictions: Meet the requirements of Section 03052 for substrate temperatures, epoxy formulation and thermal controls where precast segments are jointed with epoxy. Measure the substrate temperature at the mid-depth of the top slab for box girder sections.

4. Permissible Loads on Cantilever: During balanced cantilever erection, unbalance the cantilever by only one segment at any time. In addition to the unbalanced load due to one segment, the cantilevers are designed for loads applied by the erection equipment as listed on the Contract Drawings. Use alternate erection methods which comply with the assumptions on the Contract Drawings or otherwise approved by the Engineer.

5. Falsework and Formwork: Support falsework and formwork at closure pours by the cantilever ends or terminating segments of each series of segments to be joined. Secure cantilever together vertically, longitudinally, and transversely so that the applied loads will yield equal deflections to both cantilevers. Do not remove securing devices until the closure pour concrete has reached its required strength and longitudinal continuity tendons are tensioned. Submit calculations and details to verify that the devices and methods have adequate rigidity and do not impose excessive loads and stresses on the structure.

6. Precast Box Pier Construction - Erection Tolerances

   a. Ensure that maximum differential between outside faces of adjacent segments in the erected position do not exceed 3/16 inch.

   b. Ensure that the rotational angular deviation, measured about a vertical line, between two successive segment joints does not exceed 0.001 rad.

   c. Ensure that the maximum angular deviation of a segment from a vertical line does not exceed 0.003 rad. and that the maximum overall deviation from the vertical, measured in any direction, does not exceed 0.01 in/ft of height.

   d. Ensure the base precast segment is within 1/2 inch of the plan location.

7. Epoxy Jointing of Precast Segments: Meet the requirements of Section 03052 for epoxy jointing precast segments. Select the appropriate epoxy material based on the job requirements as either normal or slow set epoxy within the formulation temperature range based on the substrate temperature.

8. Packed Mortar Joints for Joints, Bearings or setting Pier Shaft Segments: Where designated on the Contract Drawings, place packed mortar after the precast element or bearing has been set at the proper final elevation.

   a. Pressure grouting the joint may be allowed with the Engineer's approval of the materials and method to be used. Additionally, where precast piers are shown connected to the footings by packed mortar, temporarily supporting the base segment and casting the footing around the segment will be allowed.

   b. Minimum penetration of the base segment into the footing shall be 2 inches. No additional payment for this operation or for additional footing concrete will be made.

   c. Mortar for packing consists of one part cement and one part fine aggregate, by volume, mixed with a non-shrink admixture as recommended by the manufacturer. Mix the dry elements thoroughly to a uniform mixture. Add water to produce a mealy, slightly adhesive mixture. Pack the mortar until a water sheen is produced on the surface of the mortar.

d. Build a form around the joint leaving one side open. Secure the form to withstand the required packing forces. Insert a small amount of mortar into the open joint to form a 2 inches thick bead on the opposite side of the form. Pack this bead by striking a special tool made of 1/2 by 2 inch steel having a length approximately 10 inches longer than the largest dimension of the joint being packed with a 2 pound hammer. Continue compaction until water begins to bleed out of the mortar. When bleeding has occurred, insert another bead of mortar and pack as described above. Continue this process until the joint is filled to the limits shown in the Contract Drawings.

9. Barrier Setting: Prior to forming the barriers, accurately establish the as-constructed gutter line elevations at intervals not exceeding 10 feet. Then form the base of the barrier and median to provide an inside vertical face which extends from the surface of the concrete structure to an elevation located 3 inches (or as shown on the Contract Documents) above the theoretical gutter line elevations.

   a. Maintain the plan vertical height of the barriers as a minimum when variations exist between the plan profile and the actual profile of the gutter.

10. Bridge Deck Surface: Provide a "Saw Cut Grooved Surface" upon completion of superstructure segment erection and prior to opening to traffic. "Saw Cut Grooved Surface" for deck slabs shall conform to the requirements of the NJDOT Standard Specifications, Division 500 Subsection 507.03.02, Item L.

11. Install expansion joints in accordance with Section 05830.

12. Watertight Decks: Check all segment joints, closure joints and deck hole repairs and confirm that every location is watertight, upon completion of all milling and grinding activities on the riding surface.

   a. Repair all locations showing evidence of leaks by cutting a 3/8" wide x 5/8" deep groove along the leak interface. Clean and completely fill the groove with epoxy meeting the requirements of Section 03052.

   b. Dispense the epoxy into the groove using a pneumatic gun and epoxy cartridges. Clean all excess epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface.

   c. Do not smear epoxy over areas located more than 1 inch from each side of the groove.

3.03 FIELD QUALITY CONTROL

A. Field Tests

1. Test Samples: Provide additional test samples and testing for compressive strength on precast segments and field closure joints to control the construction activities and to ensure adequate strength of these components at various stages of their manufacture and assembly.

   a. Make test cylinders, in accordance with Section 03301, cured in the same manner as the structural components to ensure adequate compressive strength has been achieved in accordance with the Contract Document requirements for the following conditions:

      (1) Prior to form release and/or moving the components to storage.

      (2) Prior to post-tensioning transverse tendons if the component is less than 28 days old.

(3) Prior to placing a component into position in the structure and/or stressing of longitudinal post-tensioning tendons if the component is less than 28 days old. This requirement is based on prior acceptance by the Engineer of incorporating a segment with an erection age less than 28 days.

b. Determine the number of cylinders in accordance with the proposed method for casting, transporting and erecting the various components.

c. Provide the results of the compression testing of one or more test cylinders for controlling the time of execution of the various construction operations.

END OF SECTION

SECTION 03432

PRECAST SEGMENTAL CONCRETE BRIDGES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Segment Shop Drawings

   a. A schedule of materials for segment fabrication including concrete, reinforcing steel, prestressing steel, grout, and other similar items.

   b. Each segment designation and the direction of erection.

   c. Segment dimensions including widths, lengths, thicknesses, tapers, fillets, radii, working points, post-tensioning, clearances, rebar dimensions and spacing, embedded items, holes, anchorages positions, and other similar items.

   d. Post-tensioning requirements as outlined in Section 03250. Check post-tensioning for consistency with pre-approved post-tensioning hardware and provide part numbers for Authority pre-approved systems on the shop drawings. Substitution of parts or materials is not allowed.

   e. The volume of concrete, weight of reinforcement and weight of post-tensioning in each precast segment and the total weight for reinforcement and post-tensioning for both the superstructure and substructure summarized and tabulated on the shop drawings.

   f. Details for any localized strengthening for concentrated supports and loads or reactions from any special erection equipment placed in locations not already allowed for in the Contract Drawings.

   g. Details for any modifications to segment geometry, cross section dimensions, or segment length including any required changes to reinforcing and post-tensioning.

   h. Details of permanent and temporary embedded items including inserts, blockouts, temporary openings, holes, and other similar items; and any localized required strengthening and the materials and methods to fill and finish the holes.

2. Casting Yard

   a. Procedures for segment fabrication including layout of the casting yard, set up and operation of the casting cells, movable rain and sun shades, geometry control stations, the storage and handling of rebar cages. the preparation of as built geometry data, placing and finishing concrete, curing of concrete, form stripping, bond breaking, and other similar items.

   b. Details for lifting, storage and stacking of segments. Additional strengthening of the segments to accommodate stacking will be at no expense to the Authority and subject to the approval of the Engineer.

   c. Equipment for segments fabrication, including details of the forms and casting cells for the manufacture of the segments, surveying the segment, lifting and transportation of the segment in the yard, and other similar items.

d. Segment storage including layout of the storage area, method of supporting the segments, single or double stacking, placing erection marks and segment identification, and other similar items.

e. Segment transportation from the casting yard to casting yard storage; storage to the site; any intermediate transportation such as from site storage to erection site.

(1) If any segment transport occurs on public roads, provide a map of the proposed route as well as any permits required by local and/or state authorities.

(2) For transport on local roads, provide:

(a.) Escort requirements

(b.) List of utilities on the route and mitigation of any geometric interferences

(c.) List of structures (culverts, bridges, retaining walls) on the route and signed/sealed calculations proving the structural adequacy of the structures to withstand the anticipated loads without damage.

(3) If any segment transport occurs over the existing Bayonne Bridge, in any configuration of the bridge, submit proposed loadings (axle loads and spacings) to the Engineer for evaluation and approval.

B. Manuals

1. Erection Manual: Before commencing erection operations, submit proposals for all segment erection operations to the Engineer for approval. This submittal must be in the form of an "Erection Manual" and include but not necessarily be limited to:

a. A detailed step-by-step sequence for the erection of each segment including all intermediate procedures relating to erection equipment, temporary and permanent post-tensioning and making of closures between spans and/or cantilevers and other required sequencing.

b. Positioning, use and sequencing of falsework, jacking and/or releasing of falsework, temporary towers, supports, tie-downs, counterweights, closure devices and the like.

c. Positioning, use and sequencing of erection equipment such as cranes, beam and winch devices, gantries, trusses and the like, both on and off the structure, including the movement, introduction and/or removal of any supports onto or connections with the structure. Include drawings and calculations for the structural effects of erection equipment on the structure.

d. Detailed scheduling of all temporary and permanent post-tensioning operations and sequences in accordance with the segment erection and closure operations and other required scheduling.

e. Stressing forces and elongations for post-tensioning.

f. Sequencing of grouting operations.

g. A method for the field survey control for establishing and checking the erected geometry (elevations and alignments) with particular attention to the setting of critical segments such as, for example, pier segments for balanced cantilever erection. This information may be included in the Erection Manual or may be provided later as a supplementary or separate document.

h. Any other relevant operations as required and applicable to the structure type and construction method.

2. Manual for Geometry Control and Casting Curves: Before commencing the casting operation, submit the proposed method of geometry control for all segment casting operations to the Engineer for approval. This submittal must be in the form of a "Casting Manual" and include but not necessarily be limited to:

   a. All measuring equipment, procedures and the location of control points to be established on each segment.

   b. The location and values of all permanent benchmarks and reference points in the precasting yard.

   c. A geometry control procedure for the vertical and horizontal alignment control for the precasting of segments; including survey controls and procedures, observations, checks, computational and/or graphical methods and correction techniques.

   d. The casting curves which include the theoretical geometric horizontal alignment, profile grade and superelevation appropriately combined with the camber.

   e. The casting manual shall cover all geometry control operations necessary and is compatible with the chosen methods of casting and erection, including erection survey, elevation and alignment control. Prepare the manual in accordance with submittal requirements of this Section.

C. Calculations

1. Calculations for any localized strengthening for concentrated supports and loads or reactions from any special erection equipment placed in locations not already allowed for in the Contract Drawings.
2. Calculations for any modifications to segment geometry, cross section dimensions, or segment length including any required changes to reinforcing and post-tensioning.
3. Calculations for lifting, storage and stacking of segments.
4. Calculations for the structural effects of erection equipment on the structure.
5. Calculations to verify that the devices and methods have adequate rigidity and do not impose excessive loads and stresses on the structure.
6. Calculations proving the structural adequacy of existing structures to withstand the anticipated loads without damage from segment transport.

END OF APPENDIX "A"

DIVISION 3

SECTION 03602

GROUTING (NON-METALLIC)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for non-metallic, non-shrink, cement-based grouting.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C 191	Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM C 827	Test Method for Early Volume Change of Cementitious Mixtures

1.03 JOB CONDITIONS

Do not mix or place grout when the ambient temperature is below 40 degrees F or conditions indicate that the ambient temperature will fall below 40 degrees F within 72 hours, unless the areas to be grouted are enclosed and heated in an approved manner or otherwise approved by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver grout in the manufacturer's sealed original bags or containers bearing the manufacturer's name and product identification, in a manner to prevent damage by breakage, water or moisture.

B. Store all material on platforms and cover as necessary to protect it from water and moisture.

C. Deliver, protect and handle all tools and equipment in a manner to prevent damage that may make them defective for the purpose for which they are intended.

1.05 SUBMITTALS

See Appendix "A" for Submittal Requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Grout shall be one of the following:

1. "Masterflow 713" - manufactured by Master Builders
2. "Five Star Grout" - manufactured By U.S. Grout Corporation
3. "Euco N-S Grout" - manufactured by Euclid Chemical Co.

B. Grout shall be premeasured and prepacked by the manufacturer, requiring only addition of potable water for mixing.

PART 3. EXECUTION

3.01 PREPARATION

Areas to be grouted as shown on the Contract Drawings shall be cleaned of all foreign materials, to the satisfaction of the Engineer.

3.02 MIXING AND PLACING

A. Use only the crew trained by the manufacturer's representative.

B. Mix and place the grout in accordance with manufacturer's methods approved by the Engineer.

C. Placement shall be continuous to avoid cold joints and voids. Grout shall be rodded or spaded to prevent the formation of air pockets.

3.03 FIELD TESTS

A. The Engineer may take and test samples of the grout being placed in accordance with ASTM C 109, C 191 and C 827.

B. In the event that tests of the grout placed reveal any failure to meet requirements of this Section, the Engineer will require removal and replacement of all portions of grout from the batch from which the sample was taken and the discontinuance of grouting until the Contractor has demonstrated to the satisfaction of the Engineer that the causes for failure have been corrected.

END OF SECTION

SECTION 03602

GROUTING (NON-METALLIC)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

03602C01 Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, a sample of the grout material for approval.

Construction and Installation Procedures

03602G01 Submit manufacturer's instructions and methods for handling, storage, mixing and placing of the grout, for approval.

END OF APPENDIX "A"

DIVISION 3

SECTION 03603

RE-GROUTING POST-TENSIONING SYSTEM

PART 1. PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies requirements for dewatering, preparing and re-grouting voids in existing post-tensioning tendons located in the arch abutment on the New Jesey side of Kill van Kull. All work is to be in accordance with the details shown on the Contract Drawings.

B. The Work includes furnishing and installing appurtenant items necessary for the particular post-tensioning system used.

1.02 All accessible existing grout caps shall be replaced. (See Contract Drawings for more information.) REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM International)
ASTM	*Standard Specification for:*
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
	Post-Tensioning Institute (PTI)
PTI M55-1.12	Specification for Grouting of Post-Tensioned Structures

1.03 DEFINITION OF TERMS

A. Post-Tensioning: The application of a compressive force to the concrete by stressing tendons or bars after the concrete has been cast and cured. The force in the stressed tendons or bars is transferred to the concrete by means of anchorages.

B. Post-Tensioning Scheme or Layout: The pattern, size and locations of post-tensioning tendons shown on the Contract Drawings.

C. Post-Tensioning System: A proprietary system where the necessary hardware (anchorages, wedges, strands, bars, couplers, etc.) is supplied by a particular manufacturer or manufacturers of post-tensioning components.

D. Tendon: A high strength steel member made up of a number of strands.

E. Strand: An assembly of seven high strength steel wires wound together. Strands typically have six outer wires helically wound around a single straight wire of a similar diameter.

F. Wire: A single, small diameter, high strength steel member and, normally, the basic component of strand, although some proprietary post-tensioning systems are made up of individual or groups of single wires.

G. Anchorage: An assembly of various hardware components which secure a tendon at its ends after it has been stressed and imparts the tendon force into the concrete.

H. Wedge: A small conically-shaped steel component placed around a strand to grip and secure it by wedge action in a tapered hole through a wedge plate

I. Wedge Plate: A circular steel component of the anchorage containing a number of tapered holes through which the strands pass and are secured by conical wedges.

J. Duct: Any steel or plastic pipe embedded in the concrete, or passing through a drilled hole, through which a post-tensioning tendon passes.

1.04 QUALIFICATIONS

A. Perform all work described in this Section under the direct, full-time supervision of a person who is a Certified Grouting Technician as certified by the American Segmental Bridge Institute (ASBI) or has a Level 2 Bonded PT – Field Specialist Certification issued by the Post-Tensioning Institute (PTI). Submit proof of certification before starting work and following any personnel changes.

1.05 SUBMITTALS

A. See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 GROUT FOR TENDONS

A. General: Grout used to fill voids in tendons shall consist of a commercially available, pre-packaged, cement-based grout mixture meeting the requirements of this Specification and approved by Engineer. Pre-packaged grout mix shall be stored and mixed in accordance with PTI M55-1.12 and manufacturer's written recommendations.

B. Grout Properties:

1. Prior to beginning grouting operations, the Contractor shall furnish the Engineer with results of tests, performed by a laboratory approved by the Engineer, demonstrating that the grout mixture meets the requirement of this Specification.

a. This information shall include a graph relating compressive strength of the grout to age, covering ages from 24 hours to 28 days.

C. Required Properties:

1. Grout shall have the properties shown on the Contract Drawings.

2.02 GROUT CAPS

A. Provide new permanent galvanized steel grout caps sized to entirely cover the existing anchorages as indicated in the Contract Drawings. Provide grout caps in accordance with the Contract Drawings.

1. Use ASTM A307 bolts to secure the new grout caps to the existing bearing plates.

2. Provide caps with two grout injection ports at the top of the cap.

3. Galvanize caps in accordance with ASTM A123. Galvanize grout cap bolts in accordance with ASTM A153. Any damage to a galvanized surface shall be repaired in accordance with ASTM A780.

PART 3. EXECUTION

3.01 GENERAL

A. The work performed under this Section is based on the undated report "Post Tension Grout Inspection and Borescope Inspection" by Boswell Engineering. Work is classified as follows:

1. Cap only: No voids were detected. Install a new permanent cap as described below and re-grout the cap.
2. Small void: Voids are present in the cap and anchor region but do not extend past the anchor trumpet. Install a new permanent cap and use low pressure grout injection to "top off" the voids.
3. Large voids new cap: These voids extend into the duct past the end of the anchor trumpet or may be isolated to a specific length of duct. Install a new permanent cap and use vacuum assisted grouting to fill the duct.
4. Large voids with water and/or soft grout: These locations contain large voids that extend into the duct past the end of the anchor trumpet or may be isolated to a specific length of duct that also contains water. Dewater the void in the duct, remove loose and unsound grout, use vacuum assisted grouting to fill the duct and install a new permanent cap. The removal of the water and/or of the soft grout is incidental to regrouting.

B. Submit a Re-grouting Plan that lists all materials and procedures to be followed for each of the above listed classifications. Specific requirements for the various types of work are listed below.

3.02 PREPARATION

A. Cap/Grout Removal: Existing grout caps and grout behind anchor plate between strands shall be removed and disposed. Contractor shall take care to not damage existing strand ends, anchor plates, wedges or other components of prestressing system to remain in place.

B. Dewatering: Water exists in approximately 25% of the vertical tendons with voids. The water depth varies from a few inches to more than five feet. All water must be removed before re-grouting commences.

C. Cleaning and Preparing: All soft and unsound grout shall be removed prior to re-grouting.

D. Inspecting: After dewatering, cleaning and preparing the tendon and prior to re-grouting, inspect each location with a borescope to ensure the tendon has been properly prepared. Tendons shall be inspected in the presence of the Engineer within 24 hours of grout placement.

E. Grout Port Drilling: An additional grout or vent port may be required to be drilled through the wedge plate into the anchorage zone to enable preparing and grouting operations. The contractor shall determine locations and number of anchorages requiring grout port drilling.The Contractor shall take care to not damage existing strand ends, anchor plates, wedges or other components of prestressing system to remain in place. The location, size and cutting/drilling procedures of any proposed holes shall be clearly described in the Re-Grouting procedure prepared by Contractor.

3.03 GROUTING

A. General:

1. After dewatering and tendon preparation has been completed and accepted, the void shall be grouted within 72 hours in accordance with this Specification. Immediately after dewatering and preparation, grout vents of each tendon shall be temporarily sealed with plugs to prevent entrance of air or water and left in place until just prior to tendon grouting.

B. Equipment:

1. Equipment for mixing grout shall be capable of continuous mechanical mixing of the grout to produce a grout which is free of lumps and in which the ingredients are thoroughly dispersed.
2. The grouting equipment shall contain a screen having clear openings of 1/8 inch maximum size to screen the grout prior to its introduction into the grout pump. If a grout with a thixotropic additive is used, a screen opening of 3/16 inch will be satisfactory. This screen shall be easily accessible for inspection and cleaning.
3. Grout pumps shall be capable of pumping grout in a manner which complies with the provisions of this Specification. Pumps shall be a positive displacement type capable of producing an outlet pressure of not less than 150 psi with seals adequate to prevent introduction of oil, air or other foreign substance into the grout and to prevent loss of grout or water. A pressure gauge having a full scale reading of no greater than 300 psi shall be placed at some point in the grout line between the pumping outlet and the duct inlet.
   a. For vacuum grouting operations provide a vacuum pump, volume-measuring device, grout flow meter, filter system, valves and fittings as necessary. Provide hand held power tools as necessary for drilling anchor holes and cleaning surfaces of existing anchors and concrete.
4. The grouting equipment shall utilize gravity feed to the pump inlet from a hopper attached to and directly over it. The hopper must be kept at least partially full of grout at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

C. Mixing Grout:

1. Grout shall be mixed in accordance with the written recommendations of the grout manufacturer.
2. The grout shall be mixed until a uniformly blended mixture is obtained and shall be continuously agitated until it is introduced into the grout pump. Batches of grout shall be placed within 30 minutes of mixing. Water shall not be added to the grout to modify its consistency after the initial mixing operation is completed.

D. Placing Grout:

1. Perform re-grouting operations in accordance with PTI M55.1-12 except for the following.

   a. Use vacuum assisted grouting where necessary to ensure that voids are completely filled as determined by the Engineer.

   b. If low pressure grouting is performed on caps and small voids, do not exceed a pressure of 10 psi unless a higher pressure is needed and approved.

   c. Notify the Engineer before starting grouting operations at a given location and complete all grouting operations at a given location (vertical face or top surface) in a single day.

   d. Inspect the grout caps, in the presence of the Engineer, 24 hours after grouting to verify that the ducts and caps were adequately grouted. If voids or soft grout are detected, remove the soft grout and re-grout as needed using vacuum assisted grouting methods at the Contractor's expense.

2. When it is anticipated that the air temperature will fall below 32 deg F, ducts shall be kept free of water so as to avoid freeze damage to ducts. Grouting shall not be done when the temperature of the grout is below 45deg F. The temperature of the concrete or air surrounding the tendon shall be maintained at 35deg F or above from the time grout is placed until the compressive strength of the grout, as determined from tests on two-inch cubes cured under the same conditions as the in-place grout, exceeds 800 psi.

3. Under hot weather conditions, grouting shall take place early in the morning when daily temperatures are lowest. Grouting shall not be done when the temperature of the grout exceeds 90 deg F. It may be necessary to chill mixing water or take special measures to lower the grout temperature.

4. After the grout has set, pipes used as injection or vent ports shall be cut off.

5. Remove any grout spilled after all grouting operations have been completed. Do not leave any hardware, trash, tools or other similar loose material on or around the abutment.

3.04 PROTECTION OF PRESTRESS ANCHORAGES

A. As soon as possible, but not to exceed 14 days, after grouting is completed, exposed surfaces of anchorages and grout caps shall be cleaned of rust, misplaced mortar, grout, and other foreign material. Immediately following the cleaning operations, the entire exposed surface of the anchorage and grout cap shall be thoroughly dried and uniformly coated as follows:

1. For galvanized components: Treat damaged areas in accordance with ASTM A780 then apply one coat of sprayed zinc to the entire exposed surface. Blast cleaning shall be limited to damaged areas with damaged galvanizing and a strip ½ inch ± ¼ inch wide around the damaged area.

3.05 GROUT TESTING

A. Testing of production grout shall be in accordance with PTI M55-1.12

4.01 METHOD OF PAYMENT

A. The grouting of the postensiong system shall be paid by the length of tendon grouted.

B. The replacement of the grout caps shall be paid by the number of caps replaced

C. The estimated quantities are:

- 600' of horizontal tendon re-grouting
- 1140' of vertical tendon re-grouting
- 348 new caps

Work greater or lesser than that will be subject to the provisions of Division 1 Specifications as to payment.

END OF SECTION

DIVISION 3
SECTION 03603

RE-GROUTING POST-TENSIONING SYSTEM

SUBMITTALS

APPENDIX "A"

The following items shall be submitted to the Engineer for approval except as otherwise noted.

A. Shop Drawings
   1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples."
   2. Shop drawings for replacement grout caps, bolts, ports and seals.

B. Catalog Cuts, Material Certification, Material Specifications and Test Results
   1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples."
   2. Mill certifications for caps, bolts and other fabricated components.
   3. Manufacturer's product and test data for proposed grout including the strength gain with age graph noted in 2.01 B.1.a.

C. Erection Procedure and Work Plan
   1. Detailed Re-grouting procedure specific to this project including proposed equipment, tendon preparation procedures, venting, materials, appurtenances, suppliers, schedule, etc.
   2. Manufacturer's handling, storage, and mixing requirements for grout.

D. Qualification
   1. Qualifications of personnel responsible for grouting operations in the field, see 1.04 A.

END OF APPENDIX "A"

DIVISION 3

SECTION 03730

CONCRETE SPALL REPAIRS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the repair of deteriorated or delaminated concrete on horizontal, vertical or overhead surfaces, by means of concrete spall repair materials.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-277	Rapid Determination of the Chloride Permeability of Concrete.

American Concrete Institute (ACI)

ACI 503R-30	Pullout Strength Test. Appendix A
ACI 546.1R-80	Guide for Repair of Concrete Bridge Structures.

American Society for Testing and Materials (ASTM)

ASTM A 185	Steel Welded Wire Fabric, Plain for Concrete Reinforcement.
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 78	Flexural Strength (Modulus of Rupture)
ASTM C 109	Compressive Strength. Modified
ASTM C 157	Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
ASTM C 403	Time of setting of Concrete Mixtures by Penetration Resistance.
ASTM C 666	Rapid Freeze/Thaw Durability, Procedure A.
ASTM C 928	Specification for Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs.

Steel Structures Painting Council (SSPC)

1.03 PERFORMANCE REQUIREMENTS

Concrete spall repair materials shall be certified by an independent testing laboratory for compliance with the following minimum requirements:

A. Concrete Spall Repair Material for Vertical or Overhead Applications.

1. Bond Strength

   The concrete spall repair material shall be tested as follows:

   a. A test panel, 2 ft. long X 1 ft. wide X 3 inches deep, shall be installed in an overhead position.

   b. A total thickness of 2 1/2 inches of the concrete spall repair material shall be applied in two lifts within the overhead test panel.

   c. After a 28-day dry-curing period, specimens shall be sawcut or cored into the overhead test panel, penetrating a minimum of 1/2 inch into the substrate. Each specimen shall be tested in direct pull out tension to attain a minimum bond strength of 25 psi. Acceptable specimen configurations shall be 3-inch or 4-inch diameter cores, or square specimens sawcut with a 4 inch side.

2. Length Change

   The concrete spall repair material shall attain a shrinkage value no greater than – 0.15% after 28 days in air; and an expansion value no greater than 0.15% after 28 days in water. Preparation and testing of specimens shall be performed in accordance with the test method specified in ASTM C-157, except that shrinkage or expansion observations shall be recorded at the times specified in ASTM C-928.

3. Compressive Strength

   The concrete spall repair material shall be tested in accordance with ASTM C-109 Modified, and shall attain minimum compressive strengths of 1000 psi in 24 hours, and 4000 psi in 28 days.

4. Flexural Strength

   The concrete spall repair material shall be tested in accordance with ASTM C-78, and shall attain a minimum flexural strength of 600 psi in 28 days.

5. Time of Set

   To determine the workability of the concrete spall repair material, its initial and final set times shall be tested in accordance with ASTM C-403.

6. Durability

   The concrete spall repair material shall be tested in accordance with ASTM C-666, Method A. The test specimens shall have less than 10% weight loss after 300 cycles of testing, and the Relative Dynamic Modulus of Elasticity (R.D.M.E.) shall be no less than 75% of the original value.

7. Permeability

The concrete spall repair material shall be tested in accordance with AASHTO T-277, "Rapid Determination of Chloride Permeability of Concrete", to yield a permeability value of less than 1000 Coulombs.

B. Concrete Spall Repair Material for Horizontal Applications

1. Bond Strength

The concrete spall repair material shall be wet-cured for 28 days and tested in accordance with ACI-503R-Appendix A. The concrete spall repair material bond strength for roadways, bridge decks and other vehicular load carrying concrete surfaces shall be a minimum of 200 psi. For other concrete surfaces not subjected to vehicular traffic the bond strength shall be no less than 100 psi.

2. Length Change

The concrete spall repair material shall be tested in accordance with ASTM C-157, except that it shall attain a shrinkage value no greater than –0.10% after 28 days in air; and an expansion value no greater than 0.10% after 28 days in water.

3. Compressive Strength

Compressive strength testing for neat pastes shall be performed in accordance with ASTM C-109. Materials extended with No. 8 aggregate, shall be tested in accordance with ASTM C-39. Test cylinders shall be a minimum of 3 inches in diameter. The minimum compressive strength shall be 2000 psi in 6 hours or 3000 psi in 24 hours, unless otherwise shown on the Contract Drawings.

4. Flexural Strength

The concrete spall repair material shall be tested in accordance with ASTM C-78; and shall attain a minimum flexural strength of 600 psi in 28 days.

5. Time of Set

The initial set time and final set time of the concrete spall repair material shall be determined in accordance with ASTM C 403.

6. Durability

The concrete spall repair material shall be tested in accordance with ASTM C-666, Method A. The test specimens shall have less than 10% weight loss after 300 cycles of testing, and the Relative Dynamic Modulus of Elasticity (R.D.M.E.) shall be no less than 75% of the original value. This requirement will not apply at locations where freeze-thaw cycles do not occur or for temporary patching.

7. Permeability

The concrete spall repair material shall be tested in accordance with AASHTO T-277, "Rapid Determination of Chloride Permeability of Concrete", to yield a permeability value of less than 1000 Coulombs. This requirement will not apply to indoor applications.

1.04 ENVIRONMENTAL REQUIREMENTS

A. All work in this section shall be performed in accordance with the environmental requirements specified by the manufacturer of each concrete spall repair material, unless otherwise indicated herein or on the Contract Drawings. In case of conflict the more stringent requirements shall apply.

B. Cold Weather Requirements

1. Do not mix or place the concrete spall repair material when the ambient temperature is below 45 degrees Fahrenheit, or when conditions indicate that the temperature will fall below 45 degrees Fahrenheit within 72 hours, unless special mixing and placement procedures are approved by the Engineer.

2. Take all necessary precautions to insure that the temperature of the concrete spall repair material, as placed, is a minimum of 50 degrees Fahrenheit.

1.05 QUALITY ASSURANCE

A. The Contractor shall submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397 for approval, with a copy to the Engineer, the name of a qualified representative of the concrete spall repair material manufacturer, who will be responsible for the following:

1. Provide technical information regarding proper methods of mixing and placing the concrete spall repair material.

2. Be present during the initial mixing and placing of the concrete spall repair material.

3. Be available for technical consultation when concrete spall repair material mixing or application problems arise.

4. Provide certification that the mixing, surface preparation, placement, finishing and curing procedure used during the initial placement were in compliance with the manufacturer's recommendations.

B. The Contractor shall furnish all labor, materials and equipment required to assist the Engineer in performing inspection and testing of the applied concrete spall repair materials. The Contractor shall make scaffolding and other equipment available as necessary to permit access to all repaired areas.

C. The Contractor shall install a test patch for the Engineer's inspection and approval, a minimum of 48 hours prior to proceeding with any concrete spall repair work shown on the contract drawings. The test patch location will be designated by the Engineer.

D. The Engineer may inspect all concrete spall repair materials and application procedures at any time for compliance with the Specifications.

E. The Engineer may take and test samples of each lot of the concrete spall repair materials delivered to the work site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in the manufacturers sealed original containers bearing the manufacturer's name and product identification, in a manner to prevent damage by breakage, water or moisture.

B. Store all material on platforms and cover it as required to protect it from the elements.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. The concrete spall repair material(s) are specified on the Contract Drawings. Concrete spall repair material(s) submitted for approval, shall be accompanied by a certification indicating compliance with the requirements of Paragraph 1.03A or 1.03 B of this Specification, as applicable, and shall be submitted in accordance with the requirements of "Workmanship and Materials" of Division 1 -GENERAL PROVISIONS.

B. Stone aggregate shall be ASTM C-33, Size No. 8.

C. Reinforcing Bars shall be ASTM A-615, Grade 60.

D. Welded Wire Fabric shall be ASTM A-185.

E. Abrasive Blast Material shall be "Black Beauty", as manufactured by Reed Minerals, a Division of Harsco Corporation, South Kearny, NJ or approved equal.

2.02 EQUIPMENT

Abrasive Blast Equipment shall be as manufactured by the following, or an approved equal.

A. "Clemco" by Clementina, Oakland, CA.

B. "Pauli and Griffin" by Pauli Griffin, Vacaville, CA.

C. "Sandstorm" by Bowen Tools, Inc., Houston, TX.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. The type and extent of deteriorated or delaminated concrete to be repaired shall be as shown on the Contract Drawings.

B. Square off the concrete area to be repaired with a 1/2-inch sawcut, and shall remove all loose, deteriorated and delaminated concrete by means of pneumatic or mechanical chipping tools.

C. Removal of loose, deteriorated and delaminated concrete, efflorescence and incrustation on concrete surfaces by means of pneumatic or mechanical chipping tools shall be done as follows:

1. Pneumatic hammers heavier than nominal 30-pound class shall not be used.

2. Pneumatic hammers or mechanical chipping tools shall be operated at an angle not to exceed 45 degrees relative to the surface of the area being repaired.

3. The Contractor shall remove deteriorated concrete to a sound surface for a depth not less than 1/4 inch nor more than 3/4 inch beyond the deteriorated layer of concrete, except as noted in 3.01 F.

4. All concrete surfaces to be repaired shall be cleaned of dirt, dust, laitance and other contaminants by abrasive blasting to yield a dry and sound concrete surface. Such work shall be performed within the same work period that the installation of the concrete spall repair material takes place.

D. The Contractor shall not use power tools to remove concrete adhered to exposed reinforcing steel. Removal of concrete, rust and/or corrosion adhered to exposed rebars shall be performed by abrasive blasting to a SSPC-SP6 surface finish.

E. The Contractor shall not damage or debond reinforcing steel, or shatter concrete beyond the area to be repaired.

F. If concrete removal has exposed more than half of the perimeter of a reinforcing bar, the rebar shall be completely exposed to clear the remaining concrete by a minimum of 1/2 inch. The Contractor shall not pry up or displace rebars to accomplish this clearance.

G. Corroded reinforcing bars, which exhibit 25% loss of cross section area, or more after cleaning, shall be repaired in accordance with the Reinforcing Bar Repair Detail shown on the Contract Drawings. Payment for such work shall be at the Net Cost thereof.

3.02 REPAIR MATERIAL INSTALLATION

A. After preparing the concrete surface to be repaired in accordance with the requirements of 3.01, and immediately prior to priming, such concrete surface shall be moistened with clean water without leaving any standing water. The moist condition will not be required, if the concrete spall repair material manufacturer specifically recommends that the surface area to be repaired not be moistened.

B. The concrete surface to be repaired shall be primed by scrubbing a slurry mix of the concrete spall repair material into the substrate using a mason's brush. The slurry shall be mixed in accordance with the manufacturer's recommendations, and its application shall be immediately followed by the installation of the approved concrete spall repair material.

C. The concrete spall repair material shall be mixed, handled and placed in strict conformance with the manufacturer's instructions, and the surface shall be finished as shown on the Contract Drawings, to match the existing concrete surface.

D. Horizontal concrete repair areas greater than 3/4 inch in depth shall have the concrete spall repair material extended with size No. 8 stone aggregate in accordance with the manufacturer's recommendations, or as approved by the Engineer.

E. All concrete spall repairs shall be cured using either an approved wet curing procedure, or a water-based curing membrane. If a wet curing procedure is selected and approved, such procedure shall be maintained for the duration of the curing.

PART 4. PAYMENT

4.01 NET COST WORK

The Contractor will be compensated for the work specified in 3.01 G at the "Net Cost" for such Work. "Net Cost" shall be computed in the same manner as is compensation for Extra Work, including any percentage addition to cost, as set forth in the clause of the Contract providing compensation for Extra Work. Performance of such Net Cost Work shall be subject to all provisions of the Contract relating to performance for Extra Work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for Extra Work.

END OF SECTION

SECTION 03730

CONCRETE SPALL REPAIRS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

03730A01 As per Division 1, "Shop Drawings, Catalog Cuts and Samples."

Catalog Cuts

03730B01 As per Division 1, "Shop Drawings, Catalog Cuts and Samples."

03730B02 Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, with a copy to the Engineer, a list of the concrete spall repair materials to be used in the performance of the Contract Work. Each concrete spall repair material shall be selected from the products specified on the Contract Drawings, and shall be properly identified for the type of concrete spall repair intended:

Samples

03730C01 As per Division 1 "Shop Drawings, Catalog Cuts and Samples".

Certificates

03730E01 Submit to the Chief of Materials Engineering a certification with a copy to the Engineer indicating compliance with the performance requirements outlined in Section 1.03. This certification shall include test results conducted within the last two years.

Construction and Installation Procedures

03730G01 The manufacturer's instruction for handling, storage, mixing and placing each of the concrete spall repair materials.

Quality Assurance-Quality Control

03730L01 Submit to the Chief of Materials Engineering certification with a copy to the Engineer on Quality Assurance Procedures outlined in Section 1.05.

END OF APPENDIX "A"

03730

DIVISION 3

SECTION 03734

CONCRETE CRACK REPAIR

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for the repair of concrete cracks by the following methods:

A. Routing and Sealing.

B. Structural Epoxy Pressure Injection.

1.02 PERFORMANCE AND ENVIRONMENTAL REQUIREMENTS

A. General

1. All work under this Section shall be performed in strict accordance with the environmental requirements and instruction provided by the manufacturer of the specified product.
2. All repair materials shall be installed within the range of ambient temperatures and humidity and within the range of surface temperatures and moisture of concrete surface specified by the manufacturer of the repair material.
3. Materials shall be installed using the manufacturer's recommended and approved equipment.
4. Materials shall be cured in accordance with manufacturer's recommendations.

1.03 QUALITY ASSURANCE

A. General

1. The entity performing the Work under this Section shall have a minimum of five years experience and shall have successfully completed at least two projects within the past three years involving quantities and complexities equal to those required under this Section.
2. The Contractor shall obtain a letter signed by a duly authorized representative for the manufacturer of each repair material stating that the entity performing the repair of concrete cracks by any of the methods in Section 1.01 has equipment appropriate for the tasks and the training and experience to properly perform the work under this Section.
3. At locations determined by the Engineer, the Contractor shall perform one test repair installation for each of the methods in 1.01 to demonstrate his ability in performing the Work in strict compliance with the requirements of this section and to the satisfaction of both the Engineer and the manufacturer's representative, as per 1.03 A.5. The Contractor shall submit the plan for each test to the Engineer for approval. The sample test installation shall be performed in the same manner as proposed for production Work. The production Work shall be performed after approval of the test installation(s).

4. Where results from test repair installations or from the Engineer's core samples are found to be unacceptable, the Contractor shall propose a method for correcting all unacceptable Work, correct the Work to the satisfaction of the Engineer, and take those measures necessary to assure that all subsequent repair Work will be acceptable, all at no additional cost to the Authority. Measures shall include any or all of the following: modification of equipment, changing repair materials, or employment of more competent personnel.

5. The Contractor shall arrange for the presence of a duly authorized representative of the manufacturer of the repair material, during the first two days performance of the concrete crack repair Work, who shall ensure that the Contractor's work force has the appropriate equipment, training, and experience to properly perform the Work in strict accordance with the manufacturer's specifications and instructions. As ordered by the Engineer, the duly authorized representative may be present beyond the first two days of the Work. The payment of the additional days shall be paid at the net cost, thereof, provided the cause for additional days are not due to Contractor's poor performance.

6. All materials and equipment including extra (backup) equipment shall be at the work site and shown to be in proper calibration and working order to the satisfaction of the Engineer, before commencing with crack repairs.

B. Routing and Sealing

1. This method is to be used for the repair of concrete cracks with widths greater than 0.25 inches.

2. Cracks shall be widened by chasing cracks with saws to remove crack shoulders. Multiple sawcut passes may be required to provide a 90 degree corner with the concrete surface. Sawcut depths shall be one-half inch minimum.

3. For cracks wider than 0.25 inches, mineral filler (sand) shall be added to the repair material.

4. See Appendix B for list of approved products.

C. Pressure Injection

1. This method is to be used for the repair of concrete cracks with surface widths ranging from 0.007 to 0.25 inches. Only pressure injection with epoxy resin is to be used.

2. In repairs involving pressure injection of cracks, the Contractor may be required by the Engineer to take 2-inch diameter core samples along the path of the injected crack for examination and testing (in addition to those described in 1.03 A.3). The number of core samples per each length of crack, longer than 20 feet long, shall be determined by dividing the entire length of the crack by 20 feet and rounding to the nearest whole number. The minimum number of core samples per each length of crack, shorter than 20 feet long, shall be one. For acceptance, the cores shall show evidence that at least 90 percent of the depth of the cracks greater than 0.007 inch in width (measured on the core surface) have been filled by the injected resin, unless noted otherwise specified. Core holes shall be patched by the Contractor in an approved method and finished to match the adjacent surfaces to the satisfaction of the Engineer. The Contractor may take additional cores for testing, if and when deemed necessary by the Engineer.

3. The pressure injection equipment shall be in strict accordance with the injection material manufacturer's instructions. The pressure injection equipment shall be capable of achieving pumping pressures consistent with the recommendations of the product's manufacturer, and of mixing reactive components of injection material at a constant volume ratio within a tolerance of 5 percent. Pressure pot systems and hand-held caulking or grease guns are not permitted as pressure injection equipment, unless otherwise approved by the Engineer.

4. Locate entry ports along the path of the crack at each end and at intermediate locations spaced in accordance with the recommendations of the manufacturer of the material or as otherwise directed by the Engineer. Injection ports shall be either surface mounted or set-in drilled holes as specified. Where ports are set in drilled holes, sites for round injection ports shall be drilled to a hole diameter and depth sufficient to assure a snug fit of the port. The drill hole shall be deep enough to allow a small reservoir below the bottom of the port that shall be set into the hole a minimum of one-half inch below the surface. Holes shall be drilled using a hollow drill bit, swivel chuck, and vacuum to insure that port holes are free of pulverized concrete powder. Rotary hammer drills shall not be used.

5. Pressure injection ports and the entire path of the crack shall be sealed with the crack surface sealer material. The manufacturer's recommended surface sealer material compatible with the injection epoxy shall be allowed to cure in accordance with the manufacturer's recommendations prior to commencing with pressure injection.

6. The reactive components of the repair material shall be mixed at a constant ratio in accordance with the manufacturer's recommendations just prior to injection. The equipment shall first be activated and approximately eight ounces of mixed injection material shall be deposited into a container to insure that the equipment is working properly. When the repair material supply in the injection equipment is about to be exhausted, it shall be replenished without discontinuity of flow or change in mixing ratio.

7. For cracks in vertical surfaces the pressure injection of the repair material shall begin at the entry port at the lowest elevation. Injection shall continue at the first port until the material begins to flow out of the port at the next highest elevation. If the injection process forces water out of the port, the injection shall continue until the material flows from the higher port. The first port shall then be plugged or sealed and pressure injection started at the second port until the material flows again from the next highest port. This sequence shall be repeated until the entire set of ports in the crack or void have flowed with the material and have been sealed.

8. For horizontal surface cracks, pressure injection shall begin at one end of the visible crack and continued until the material begins to flow out of the adjacent open port. The first port shall then be plugged or sealed and pressure injection started at the second port until the material flows again from the next adjacent open port. This sequence shall be repeated until the entire set of ports in the crack or void have flowed with the material and have been sealed.

9. In the event of leakage from the sealed crack surface, the injection process will be stopped until the leak is sealed. Any work stoppage of more than fifteen minutes will require cleaning of the mixing chamber and other equipment with mixed repair material.

10. Injection pressure shall be adjusted to avoid excessive stress build-up in the concrete and further propagation of the cracks. Pressure shall be increased gradually until the resin flows from the adjacent port.

11. After the pressure injection is complete, allow the repair material to cure fully in accordance with the manufacturer's recommendations. Drill out and/or remove ports and surface sealer. Fill injection port holes with the same epoxy used for injection. Finish the surface to be flush with and to match with the adjacent existing finish. A power grinder shall be used to finish the surface unless otherwise shown on the Contract Drawings.

12. See Appendix B for list of approved products.

1.04 DELIVERY STORAGE, AND HANDLING

A. Deliver all materials in the manufacturers sealed original containers bearing the manufacturer's name and product identification, and batch or lot number clearly identified, in a manner to prevent damage by breakage, water or moisture.

B. Store all repair material on platforms and cover it as required to protect it from the elements. Materials shall be maintained within the manufacturer's recommended storage temperature range.

C. All materials shall be used during their manufacturer's recommended shelf life, but not after one year from the date of manufacture.

D. The Engineer will request samples, or will sample materials on site, no more than once per week. These samples will be stored and subject to testing to verify conformance to the manufacturer's specifications.

1.05 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. For each repair method, the Contractor shall select and use a corresponding product from Appendix "B", List of Approved Products. No substitution(s) will be allowed.
2. All crack repair material components shall be supplied by the same manufacturer.
3. Solvents used for cleaning shall be approved by the product's manufacturer and shall be non-chlorinated.

PART 3. EXECUTION

3.01 EXAMINATION

Prior to commencing with the Work, the cracks to be repaired shall be thoroughly examined and the complete path shall be mapped on the exterior concrete surface.

3.02 PREPARATION

A. General

1. All loose concrete material in the vicinity of the crack and crack reservoir shall be removed and the crack path shall be cleaned of dirt, laitance and other contaminants in accordance with the surface preparation in the manufacturer's specifications. Cleaning the surface and the cracks may involve solvent cleaning, washing and/or flushing.
2. Concrete surfaces and routed cracks which are designated to be sealed shall be cleaned by abrasive blasting and then by blowing with oil-free air in order to remove substances which may interfere with adhesion of the sealer materials.
3. The Contractor shall coordinate cleaning, vacuuming, wetting, drying and surface preparation. Vacuum the concrete surfaces and all cracks after cleaning to remove all residue, dirt, sand and grit.
4. Protect adjacent existing finished surfaces from damage or marring of finishes as approved by the Engineer.
5. All residue and debris resulting from the Contractor's Work shall be placed in labeled containers supplied by the Contractor and shall be removed from the site and properly disposed of by the Contractor.

3.03 APPLICATION

A. General

1. The Contractor shall be required to have present, a manufacturer's technical representative, as per 1.03 A.5, to ascertain that each different type of repair is being performed correctly and successfully.
2.

END OF SECTION

SECTION 03734

CONCRETE CRACK REPAIR

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts, Material Certification and Test Results

1. Shop Drawings, Catalog Cuts and Samples.
2. Catalog Cuts for equipment used for installation of repair materials.

B. Construction Procedures and Quality Assurance Documents

1. Evidence of the experience of the entity performing the Work as required in 1.03 A.1 including the names and addresses of previous clients to be used as references.
2. Letter from the manufacturer in accordance with 1.03 A.2.
3. List of all materials to be used for crack repairs, including complete manufacturer's certification and recommendations including execution and application procedures for the repair materials to be used in each of the repair method of Section 1.01, in accordance with Appendix "B".
4. Method of patching core holes, including proposed materials, as required in 1.03 C.2 and method of finishing the concrete surface as required in 1.03.C11
5. The Contractor's plan for sample test for the Engineer's approval in accordance with 1.03 A.3.
6. The qualifications and experience of personnel who constitute the work force performing the Work, defined in 1.03 A.5, to the satisfaction of the Engineer.
7. The names, qualifications and experience of the duly authorized representatives of the manufacturers who will be present during the crack repair Work, in accordance with 1.03 A.5.

END OF APPENDIX "A"

SECTION 03734

CONCRETE CRACK REPAIR

APPENDIX "B"

LIST OF APPROVED PRODUCTS

A. Routing and Resealing: These products are to be used for concrete cracks with widths greater than 0.25 inches.

Brand Name	High/Low Modulus	Manufacturer
Sikadur 23 Lo-Mod Gel	Low	Sika Corp. U.S.
Sikadur 31 Hi-Mod Gel	High	Sika Corp. U.S.
Euco #452	High	Euclid Chemical Co.
Concresive Standard LVI	High	BASF Construction Chemicals

B. Pressure Injection: These products are to be used for concrete crack widths ranging from 0.007 to 0.25 inches.

Brand Name	High/Low Modulus	Manufacturer
Sikadur 35 Hi-Mod LV	High	Sika Corp. U.S.
Sikadur 52	High	Sika Corp. U.S.
Sure-Inject J56 SLV	High	Dayton Superior
Sure Inject J56	High	Dayton Superior
Eucopoxy Injection Resin	High	Euclid Chemical Co.
Concresive 1380	High	BASF Construction Chemicals
Concresive Standard LVI	High	BASF Construction Chemicals

Note: The surface sealer materials shall be compatible with the injection materials listed above and shall be supplied by the same manufacturer as approved by the Engineer.

END OF APPENDIX "B"

DIVISION 4

SECTION 04060

MASONRY MORTAR

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for cementitious mortar for use with brick, concrete and glass unit masonry.

B. Refer to other Division 4 Sections on unit masonry for installation of masonry mortar.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/ The Masonry Society (TMS)
ACI 530.1/ASCE 6 /TMS 602	Specification for Masonry Structures.
	American Society for Testing and Materials (ASTM)
ASTM C 91	Specification for Masonry Cement.
ASTM C 144	Specification for Aggregate for Masonry Mortar.
ASTM C 150	Specification for Portland Cement.
ASTM C 207	Specification for Hydrated Lime for Masonry Purposes.
ASTM C 270	Specification for Mortar for Unit Masonry.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in unopened packages legibly marked with manufacturer's name, brand and label information.

B. Deliver, store and handle materials to prevent damage by water or moisture and contamination by foreign materials.

1. Store cementitious materials on elevated platforms or in dispensing silo and under cover.

2. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Weather Requirements

Conform to requirements of ACI 530.1/ASCE 6/TMS 602 for hot and cold weather construction. Follow cold weather requirements for ambient temperatures below 40 degrees F. Follow hot weather requirements for ambient temperatures above 100 degrees F and for temperatures above 90 degrees F with wind speed above 8 mph.

B. Perform the following procedures while masonry construction is in progress. Temperature ranges indicated refer to ambient temperature at time of installation. Do not heat water for mortar above 140 degrees F.

1. 40 degrees F to 32 degrees F

   Heat mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing.

2. 32 degrees F to 25 degrees F

   Heat mixing water and sand to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing. Maintain temperature of mortar on boards above freezing.

3. 25 degrees F to 20 degrees F

   Heat mixing water and sand to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing. Maintain temperature of mortar on boards above freezing. Heat masonry surfaces to a minimum of 40 degrees F. Provide wind breaks when wind velocity exceeds 15 mph.

4. 20 degrees F and below

   Heat mixing water and sand to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing. Maintain temperature of mortar on boards above freezing. Heat masonry surfaces to a minimum of 40 degrees F. Provide wind breaks when wind velocity exceeds 15 mph and provide heated enclosure with minimum 32 degree F air temperature.

1.05 QUALITY ASSURANCE

Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Colored Masonry Cements, if any: Premixed colored masonry cements, complying with ASTM C 91, of formulation required to produce mortar color shown on the Contract Drawings, shall be one of the following or approved equal:

CEMEX, Wampum, PA, "Richcolor Masonry Cement"
Essroc Cement, Nazareth, PA, "Flamingo-Brixment Masonry Cements in Color"
Lehigh Cement Co., Allentown, PA, "Lehigh Custom Color Masonry Cement"

B. Liquid Water Repellent Admixture: Mortar for use with concrete masonry units (face wythe only) and exterior glass unit masonry shall be one of the following or approved equal:

Grace Construction Products (W.R. Grace & Co.), Milwaukee, WI, "Dry-Block Mortar Admixture" or "Mortar Tite"
Master Builders, Inc. (div. Degussa Corp.), Cleveland, OH, "Rheomix Rheopel Mortar Admixture"

2.02 MATERIALS

A. Portland Cement

ASTM C 150, Type I (normal), or Type III (high early strength) for winter construction, natural color. Winter construction occurs when ambient air temperatures for a period of 48 hours before mortar installation is below 40 degrees F.

B. Masonry Cement: ASTM C 91, for use in preparation of ASTM C 270 Type N, S or M colored mortar.

C. Hydrated Lime: ASTM C 207, Type S.

D. Mortar Aggregate

1. ASTM C 144; for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.
2. White Mortar Aggregate: Natural white sand or ground white stone as required to produce required mortar color shown on the Contract Drawings.

E. Water: Clean and potable.

F. Admixtures

Field addition at time of mortar mixing of air-entraining materials or admixtures, plasticizers, accelerators, retarders, coloring pigments, water repellent agents or other admixtures is not permitted unless specifically indicated. Submit factory produced cement and mortar blends containing admixtures to the Engineer for review.

2.03 MIXES

A. Mortar mixes and colored mortar mixes shall comply with ASTM C 270 *Proportion Specification Requirements* for types listed, except provisions under Section 8 "Quality Assurance" of ASTM C 270 regarding cost of tests shall not apply. Furnish the following mortar types as required, unless otherwise shown on the Contract Drawings:

1. Type N mortar for exterior, above grade walls and for interior walls.
2. Type M mortar for walls below grade and in contact with earth.
3. Type S mortar for grouted, vertically reinforced walls (not for use with glass masonry units).

B. Mortar Color: Natural (grey), unless otherwise shown on the Contract Drawings.

PART 3. EXECUTION

3.01 PREPARATION

A. Mix mortar ingredients in quantities needed for immediate use.

B. Measure materials by volume or equivalent weight. Do not measure by shovel.

C. Mix materials in clean mechanical batch mixer for 5 minutes.

D. Use maximum amount of water to produce workable consistency. For mortar used with glass masonry units, reduce amount of water to compensate for lack of absorption.

E. Perform hand mixing of small quantities of mortar only if approved by the Engineer.

3.02 ADJUSTMENTS

A. To restore mortar workability, retemper by adding water and remixing. Retemper mortar as required, within 1-1/2 hours after mixing. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours of initial mixing.

B. Do not retemper colored mortar. Discard colored mortar that is not used within 2-1/2 hours after mixing.

C. Do not retemper mortar for use with glass masonry units.

3.03 PROTECTION

Curing: Conform to requirements of ACI 530.1/ASCE 6/TMS 602.

END OF SECTION

SECTION 04060

MASONRY MORTAR

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

04060C01 Samples:Colored Mortar, if any: Fabricate samples for verification in a minimum 6 inch long 3/8 inch wide metal channel, using same sand and mortar ingredients to be used in the Work. Label samples to indicate types and amounts of pigments used.

Product Data

04060D01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS:A. Product data for each product

Certificates

04060E01 Certifications 1. Compliance with ASTM C 270 for masonry mortar materials.

04060E02 Certifications 2. Compliance with ASTM C 91 and C 270 for premixed colored masonry cements, if any.

Construction and Installation Procedures

04060G01 Construction and Installation Procedures: For Cold or Hot Weather (if applicable): Detailed description of methods, materials and equipment to be used to comply with cold or hot weather requirements.

Calculations

04060H01 Design Mix: List products and mix proportions for mortar and source of aggregate (for information only).

END OF APPENDIX "A"

DIVISION 4

SECTION 04070

MASONRY GROUT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for cementitious grout for use in unit masonry walls.

B. Refer to other Division 4 Sections on unit masonry for installation of masonry grout.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/ The Masonry Society (TMS)
ACI 530.1/ASCE 6/ TMS 602	Specification for Masonry Structures.
	American Society for Testing and Materials (ASTM)
ASTM C 94	Ready-Mixed Concrete.
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C 207	Specification for Hydrated Lime for Masonry Purposes.
ASTM C 404	Specification for Aggregates for Masonry Grout.
ASTM C 476	Specification for Grout for Masonry.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in unopened packages legibly marked with manufacturer's name, brand and label information.

B. Deliver, store and handle materials to prevent damage by water or moisture and contamination by foreign materials.

1. Store cementitious materials on elevated platforms or in dispensing silo and under cover.

2. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Weather Requirements

Conform to requirements of ACI 530.1/ASCE 6/TMS 602 for hot and cold weather construction. Follow cold weather requirements for ambient temperatures below 40 degrees F. Follow hot weather requirements for ambient temperatures above 100 degrees F and for temperatures above 90 degrees F with wind speed above 8 mph.

B. Perform the following procedures while masonry construction is in progress. Temperature ranges indicated refer to ambient temperature at time of installation. Do not heat water for grout above 140 degrees F.

1. 40 degrees F to 32 degrees F

   Heat mixing water to produce grout temperature between 40 degrees F and 120 degrees F at the time of mixing.

2. 32 degrees F to 25 degrees F

   Heat mixing water and aggregate to produce grout temperature between 70 degrees F and 120 degrees F at the time of mixing, and to provide in-place grout temperature above 70 degrees F.

3. 25 degrees F to 20 degrees F

   Heat mixing water and aggregate to produce grout temperature between 70 degrees F and 120 degrees F at the time of mixing, and to provide in-place grout temperature above 70 degrees F. Heat masonry to a minimum of 40 degrees F prior to grouting.

4. 20 degrees F and below

   Heat mixing water and aggregate to produce grout temperature between 70 degrees F and 120 degrees F at the time of mixing, and to provide in-place grout temperature above 70 degrees F. Heat masonry to a minimum of 40 degrees F prior to grouting, and provide heated enclosure with minimum 32 degree F air temperature.

1.05 QUALITY ASSURANCE

Obtain grout ingredients of uniform quality from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Portland Cement

ASTM C 150, Type I, or Type III for winter construction, natural color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Grout Aggregate: ASTM C 404.

D. Water: Clean and potable.

E. Admixtures: Addition of air-entraining materials or admixtures, plasticizers, accelerators, retarders, water repellent agents or other admixtures is not permitted.

2.02 MIXES

A. Grout shall comply with ASTM C 476, with proportions of ingredients determined by Table 1 *Grout Proportions by Volume*, for use in construction of reinforced and non-reinforced unit masonry.

B. Use grout type as shown on the Contract Drawings (fine or coarse) or type in compliance with ACI 530.1/ASCE 6/TMS 602 Table 1.15.1 *Grout Space Requirements.*

PART 3. EXECUTION

3.01 PREPARATION

A. Batch, mix and deliver ready-mixed grout in accordance with batching, mixing and delivery requirements of ASTM C 94. Continuously agitate after mixing, until placement.

B. Mix pre-blended dry grout materials in a clean mechanical batch mixer for 5 minutes.

C. Measure materials by volume or equivalent weight. Do not measure by shovel.

D. Use water to produce a slump between 8 and 11 inches, as measured per ASTM C 143.

E. Perform hand mixing of small quantities of grout only if approved by the Engineer.

3.02 ADJUSTMENTS

Do not retemper grout. Discard grout that is not placed within 1-1/2 hours after water is first added to the batch.

3.03 PROTECTION

Curing: Conform to requirements of ACI 530.1/ASCE 6/TMS 602.

END OF SECTION

SECTION 04070

MASONRY GROUT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

04070D01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS: Product Data for each product indicated.

Certificates

04070E01 Certifications: Compliance with ASTM C 476 for masonry grout materials.

Manufacturer Test Reports

04070F01 Test Reports: Test results supporting compliance with performance requirements for grout (compressive strength), if shown on the Contract Drawings.

Construction and Installation Procedures

04070G01 Construction and Installation Procedures: For Cold or Hot Weather (if applicable): Detailed description of methods, materials and equipment to be used to comply with cold or hot weather requirements.

Calculations

04070H01 Design Mix: List products and mix proportions for grout and list source of aggregate (for information only).

END OF APPENDIX "A"

DIVISION 4

SECTION 04170

JOINT REINFORCEMENT AND STEEL REINFORCING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for joint reinforcement and steel reinforcing for unit masonry assemblies.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/ The Masonry Society (TMS)

ACI 530.1/ASCE 6/ TMS 602	Specification for Masonry Structures.

American Society for Testing and Materials (ASTM)

ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement.
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 185	Specification for Steel Welded Wire Fabric, Plain, for Concrete.
ASTM A 497	Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
ASTM A 615	Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
ASTM A 775	Specification for Epoxy-Coated Steel Reinforcing Bars.
ASTM A 951	Specification for Masonry Joint Reinforcement.

1.03 DEFINITIONS

A. Joint Reinforcement

Horizontal joint reinforcement fabricated, generally, in truss-type configuration for placement in the horizontal mortar joints of masonry walls and partitions.

B. Steel Reinforcing

Steel reinforcing bars, generally, placed vertically in the cells of CMU walls or partitions or in the cavity of masonry cavity walls, or placed horizontally in bond beams.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint reinforcement and steel reinforcing packaged in manufacturer's original, unopened bundles with label data legibly marked. Different types and grades of products shall be packaged separately.

B. Store in a clean dry location.

C. Handle to prevent deterioration or damage due to moisture, contamination, corrosion and other causes.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products as manufactured by one of the following, or approved equal:

Joint Reinforcement:

Dur-O-Wal Inc., Div. of Dayton Superior Corp., Aurora, IL
Hohmann & Barnard, Inc., Hauppauge, NY
Wire-Bond, Charlotte, NC

2.02 MATERIALS

A. Joint Reinforcement

1. Steel Wire: ASTM A 82.

2. Finish: ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) hot-dip galvanized coating, applied after fabrication.

B. Steel Reinforcing (Horizontal or Vertical)

1. General

Furnish reinforcing steel complying with ACI 530.1/ASCE 6/TMS 602 requirements and this Section.

2. Steel Reinforcing Bars

Material and grade and size as follows, as shown on the Contract Drawings:

a. Uncoated steel reinforcing bars: ASTM A 615.

b. Epoxy-coated steel reinforcing bars: ASTM A 615 and ASTM A 775.

C. Grade 60 if bar sizes 7 to 10 are used; Grade 40 if bar sizes 3 to 6 are used; Grade 75 if bar sizes 11, 14 or 18 are used.

D. Furnish one or more of the following, where shown on the Contract Drawings:

1. Plain Welded Wire Fabric: ASTM A 185.

2. Deformed Welded Wire Fabric: ASTM A 497.

2.03 FABRICATION

A. Joint Reinforcement

Fabricate joint reinforcement in accordance with ASTM A 951 and as follows:

1. Welded-wire units with deformed, continuous side rods and plain cross rods prefabricated into straight lengths of not less than 10 feet, with prefabricated corner and tee units.

2. Width

Fabricate in widths approximately 2 inches less than nominal width of walls and partitions to provide mortar coverage of not less than 5/8 inch on joint faces exposed to exterior and 1/2 inch elsewhere.

3. Wire Size

a. Side Rods: W1.7 or 0.1483 inch diameter (9 gage).

b. Cross Rods: W1.7 or 0.1483 inch diameter (9 gage).

4. Units shall be fabricated with continuous diagonal cross rods spaced not more than 16 inches on center, placed in the same plane as longitudinal wires with one side rod for each composite wall wythe or face shell.

5. Furnish types as required for single- or multi-wythe walls as shown on the Contract Drawings, including two-piece adjustable types for cavity wall and for seismic design as required.

B. Steel Reinforcing

Fabricate steel reinforcing in maximum 12 foot lengths, unless otherwise shown on the Contract Drawings, and in accordance with approved unit masonry Shop Drawings.

PART 3. EXECUTION

3.01 INSTALLATION

A. Horizontal Joint Reinforcement

1. Install joint reinforcement in all masonry walls and partitions, unless otherwise shown on the Contract Drawings.

2. Use prefabricated "L" and "T" sections at corners and intersections. At returns, offsets, curves and other special conditions, cut and bend joint reinforcement to ensure continuity.

3. Lap joint reinforcement at least 6 inches at splices and prefabricated sections.

4. Space reinforcement as follows, unless otherwise shown on the Contract Drawings:

   a. For single- and multi-wythe walls, 16 inches on center vertically.

   b. For parapets, 8 inches on center vertically.

   c. For masonry openings greater than 1 foot wide, place joint reinforcement 8 inches apart (vertically), immediately above lintel and below sill. Extend joint reinforcement at least 2 feet beyond opening jambs.

5. Cut or interrupt horizontal joint reinforcement at control or expansion joints and terminate 2 inches back from such joints.

6. Terminate horizontal joint reinforcement 2 inches back from jambs.

B. Steel Reinforcing

Install horizontal and/or vertical bar steel reinforcing where shown on the Contract Drawings.

END OF SECTION

SECTION 04170

JOINT REINFORCEMENT AND STEEL REINFORCING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Certificates

04170E01 For horizontal joint reinforcement submit manufacturer's technical data including certification of compliance with specified standards for wire and finish in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1-GENERAL PROVISIONS.

04170E02 Submit material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements. 1. Each material and grade indicated for reinforcing bars. 2. Each type and size of joint reinforcement.

END OF APPENDIX "A"

DIVISION 4

SECTION 04220

CONCRETE MASONRY UNITS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for concrete masonry units and accessories.

B. Requirements for masonry mortar, masonry grout, masonry joint reinforcement and steel reinforcing are found in other Division 4 Sections.

C. Requirements for concealed flashing are found in other Division 7 Sections.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/ The Masonry Society (TMS)

ACI 117	Standard Specifications for Tolerance for Concrete Construction and Materials
ACI 530.1/ASCE 6/ TMS 602	Specification for Masonry Structures.

American Concrete Institute (ACI)

ACI 315	Details and Detailing of Concrete Reinforcement.

American Society for Testing and Materials (ASTM)

ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
ASTM C90	Specifications for Loadbearing Concrete Masonry Units.
ASTM C140	Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
ASTM C331	Specification for Lightweight Aggregates for Concrete Masonry Units.
ASTM C426	Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
ASTM C549	Specification for Perlite Loose Fill Insulation
ASTM C578	Specification for Rigid, Cellular Polystyrene Thermal Insulation.
ASTM C744	Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
ASTM C1093	Practice for Accreditation of Testing Agencies for Unit Masonry.

ASTM C1262	Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
ASTM C1364	Specification for Architectural Cast Stone.
ASTM D2000	Classification System for Rubber Products in Automotive Applications.
ASTM D2240	Test Method for Rubber Property–Durometer Hardness.
ASTM E119	Test Methods for Fire Tests of Building Construction and Materials.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Provide concrete masonry units that develop an installed compressive strength (f'm) of 1500 psi, unless greater compressive strengths are shown on the Contract Drawings.

B. Where fire-rated masonry construction is shown on the Contract Drawings, provide materials and construction which are identical to assemblies tested and approved by a testing and inspecting agency acceptable to the Engineer as complying with ASTM E119, by calculated fire resistance (equivalent thickness), or by other means as permitted by authorities who would have jurisdiction if the Authority were a private corporation.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Protection of Masonry

During masonry erection, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention

Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Remove immediately grout, mortar or soil that comes in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

2. Protect sills, ledges and projections from mortar droppings.

3. Protect surfaces of window and door frames and similar elements with painted and integral finishes from mortar droppings.

D. Weather Requirements

1. Conform to requirements of ACI 530.1/ASCE 6/TMS 602 for hot and cold weather construction. Follow cold weather requirements for ambient temperatures below 40 degrees F. Follow hot weather requirements for ambient temperatures above 100 degrees F, or for temperatures above 90 degrees F with wind speed above 8 mph.

2. Do not lay masonry units that are wet or frozen.

3. Remove masonry damaged by freezing conditions.

4. Erect windbreaks or enclosures when wind is 15 mph or more.

1.05 QUALITY ASSURANCE

A. Inspecting Laboratory Qualifications

The Contractor-chosen independent testing laboratory must demonstrate to the Engineer's satisfaction, based on his evaluation of laboratory-submitted criteria conforming to ASTMC1093, that it has the experience and capability to conduct the testing indicated in this Section without delaying the progress of the Work.

B. Single Source Responsibility

Obtain exposed masonry units of uniform texture and color from a single manufacturer for each type of product required.

C. Mock-ups

Before masonry Work commences, construct a panel approximately 6 foot long by 4 foot high of each type of exposed concrete masonry unit, as directed by the Engineer, for approval. Use mortar of type and color to be used in the Work.

1. Protect mock-ups from the elements with a weather-resistant membrane.

2. Retain mock-ups during construction as standards for judging completed masonry Work. When directed by the Engineer, demolish mock-ups and remove from Authority property.

3. Prepare a list of materials used to construct mock-ups, for information only, for Engineer. Include manufacturer and product names, generic materials, suppliers, colors, identifying lot or batch numbers and design mixes.

4. Where masonry is shown on the Contract Drawings to match existing, construct mock-up panel adjacent to and parallel to existing surfaces to be matched.

D. Unit Masonry Standard

Comply with ACI 530.1/ASCE 6/TMS 602 *Specifications for Masonry Structures*, except as otherwise indicated.

1. Revise ACI 530.1/ASCE 6/TMS 602 to exclude Sections 1.4 and 1.7; Parts 2.1.2, 3.1.2, and 4.1.2; and Articles 1.5.1.2, 1.5.1.3, 2.1.1.1, 2.1.1.2, and 2.3.3.9.

E. The Engineer will perform any required testing to inspect foundations for compliance with dimensional tolerances specified in ACI 117.

F. Preconstruction Testing

Employ and pay a qualified independent testing laboratory to perform the following preconstruction testing indicated as well as other inspecting and testing services required by referenced unit masonry standard or indicated herein for source and field quality control:

1. Concrete Masonry Unit Tests

Test each different concrete masonry unit shown on the Contract Drawings for dimensions, compressive strength, absorption, weight (density) and moisture content per ASTMC140. Test exposed and/or exterior units with water repellent additive for water penetration, in accordance with the requirements of ASTM E514.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle all materials to prevent damage by breaking, water or moisture and contamination by foreign materials.

B. Store materials on a clean, dry surface or platform, off ground, covered, separate from each other and protected from deterioration and the elements.

C. During freezing weather protect materials with tarpaulins or other suitable material.

1.07 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. The post-industrial and/or post-consumer recycled content (by material cost) of all concrete masonry used shall be documented in accordance with the Divison 1 Sustainability Requirements.

2. The assembly which the concrete masonry units were manufactured shall be in accordance with the material proximity section of Division 1 Sustainability Requirements.

1.08 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Special Shapes: Furnish as required by the installation or as shown on the Contract Drawings.

2. Integral Water Repellent

   Furnish units with integral liquid water repellent additive for exposed unit applications, manufactured by W.R. Grace & Co. Conn., Grace Construction Products Div., "Dry-Block," or approved equal.

   a. Where block is furnished with integral water repellent, assemblies shall include mortar containing water repellent additive by same manufacturer.

B. Concrete Masonry Units (CMU)

1. Hollow or solid load-bearing units: ASTM C90.

2. Weight Classification

   Lightweight; except furnish normal weight for exposed CMU to be painted.

3. Unit Compressive Strength: Provide units with minimum average net area compressive strength of 1900 psi.

4. Aggregate

   Lightweight aggregate, 100 percent expanded clay, shale or slate produced by the rotary kiln process and conforming to ASTM C331. The blending of screenings or any other deleterious substances which will impair the block's fire rating or insulation value shall not be permitted.

5. Linear Shrinkage: Maximum 0.065 percent, tested in accordance with ASTM C426.

6. Size: Nominal 16 inch by 8 inch face dimension, unless otherwise shown on the Contract Drawings, by thickness indicated.

7. Exposed Faces

   a. Color and Texture: Manufacturer's standard, unless otherwise shown on the Contract Drawings.

   b. Pattern: Plain face, unless otherwise shown on the Contract Drawings.

C. Decorative Concrete Masonry Units

Where special finishes are shown on the Contract Drawings, furnish ASTM C90 hollow or solid load-bearing units, with exposed faces of the following general description in color and texture shown on the Contract Drawings, or if not shown, as selected by the Engineer from manufacturer's standard color chart and six sample stretcher units which shall represent the full range of color variation.

1. Standard aggregate, ground finish.

2. Special aggregate, ground finish.

3. Standard aggregate, split face finish.

4. Special aggregate, split face finish.

5. Standard aggregate, split ribbed finish.

6. Special aggregate, split ribbed finish.

D. Ground Face or Prefaced Units

Color shall be as shown on the Contract Drawings or, if not shown, as selected by the Engineer from manufacturer's standard color chart and six sample stretcher units which shall represent the full range of color variation.

E. Ground Face Masonry Units (GFMU)

In addition to complying with 2.01 C, GFMU shall be as follows:

1. ASTM C90 hollow or solid load-bearing units, as shown on the Contract Drawings, integrally colored block with manufacturer's standard treated clear satin gloss acrylic face coating conforming to ASTM C744 with respect to adhesion, color change and resistance to crazing; and to ASTM C1262 with respect to freezing and thawing.

2. Furnish filled units with single or double face as shown on the Contract Drawings.

3. Products: Subject to compliance with the requirements of this Section, furnish and install "Trendstone"; Trenwyth Industries, Inc., Emigsville, PA, or approved equal.

F. Prefaced Concrete Masonry Units (PCMU)

In addition to complying with 2.01 C, PCMU shall be as follows:

1. ASTM C90 hollow or solid load-bearing units, as shown on the Contract Drawings, with manufacturer's standard resinous tile facing complying with ASTM C744 and 1/16 inch thick returns of facing to create 1/4 inch mortar joints with modular coursing.

2. Products: Subject to compliance with the requirements of this Section, furnish and install PCMU of one of the following, or approved equal:

   a. "Astra-Glaze-SW+"; Trenwyth Industries, Inc., Emigsville, PA.

   b. "Spectra-Glaze II"; produced by a manufacturer licensed by Spectra Development Corp. Licensing and Chemical Div., Baltimore, MD.

G. Cast Stone Sills and Copings

ASTM C1364, of shapes and sizes shown on the Contract Drawings, with finish as shown or to match samples in the Engineer's Office.

2.02 ACCESSORIES

A. Ties and Anchors

Where shown on the Contract Drawings, furnish and install products as listed below, or approved equals. Furnish hot-dip galvanized products, unless otherwise indicated herein or shown on the Contract Drawings.

1. Wire Tires

Cold-drawn steel wire, 3/16 inch diameter, ASTM A82, with ASTM A153 Class B-2 (1.5 oz. per sq. ft. of wire surface) hot-dip galvanized coating; with 2 inch ends bent at right angles to provide hooks; wire tie length as required to extend at least halfway through veneer, but held back to allow 5/8 inch thick minimum mortar cover on outside face.

2. Wall Anchors

Heckmann Building Products, Inc. Chicago, IL, No. 340-A; 16 gage corrugated galvanized steel, 1-1/2 inches wide by 6 inches long, or length as required, by 2 inches bend with 7/16 inch diameter hole.

3. Channel System Wall Anchor

a. Channel: Hohmann & Barnard, Inc. No. 360 or No. 360-C; 10 gage galvanized steel, "Gripstay Channel".

b. Anchors: Hohmann & Barnard, Inc. No. 364 or No. 365; 3/16 inch by 1-1/4 inch stainless steel, "Gripstay Anchor"; length as shown on the Contract Drawings.

4. Anchors for Securing Masonry to Steel Columns

a. Hohmann & Barnard, Inc., Hauppauge, NY, No. 353, 353L; 1-1/4 inch wide by 3/16 inch galvanized steel.

b. Hohmann & Barnard, Inc., Hauppauge, NY, No. 354; 1-1/2 inch wide by 3/16 inch galvanized steel.

5. Anchors for Securing Masonry to Steel Beams

Hohmann & Barnard, Inc. No. 357; 1-1/4 inch wide by 3/16 inch galvanized steel.

6. Intersecting Rigid Partition Anchors

Hohmann & Barnard, Inc. No. 344; 1-1/4 inch wide by 3/16 inch galvanized steel, length as required.

7. Wire Mesh Wall Ties

16 gage galvanized steel, 1/2 inch square mesh; minimum 12 inches long; width as required to provide 5/8 inch mortar cover at edges; Heckmann Building Products, Inc. No. 269, or approved equal.

8. Stone Anchors

Stainless steel, size and diameter as shown on the Contract Drawings; Hohmann & Barnard, Inc. No. 408, or approved equal.

9. Anchor Bolts

Steel bolts with hex nuts and flat washers complying with ASTM A307, Grade A, hot-dip galvanized to comply with ASTM A153, Class C, in size and configuration as shown on the Contract Drawings.

10. Dovetail Slots: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.0336-inch, galvanized steel sheet. Provide the following product, or approved equal: No. 303 and 305, or No. 315 (where applicable) by Hohmann & Barnard.

11. Premolded Control Joint Gaskets

Extruded rubber material complying with ASTM D2000 2AA-805, durometer hardness of 80 plus or minus 5 when tested in accordance with ASTM D2240; designed to fit CMU sash block; "No. RS Series" as manufactured by Hohmann & Barnard, Inc., or approved equal.

B. Compressible Filler

Premolded closed cell neoprene compressible filler strip with pressure sensitive adhesive; "No. NS" as manufactured by Hohmann & Barnard, Inc., or approved equal.

C. Weeps/Vents

Rectangular plastic tube, 1-1/2 inches by 3-1/2 inches by 3/8 inch outside width and spaced as shown on the Contract Drawings, manufactured by Hohmann & Barnard, Inc., or approved equal.

D. Insulation

1. Cavity Wall Insulation

Extruded Polystyrene Board Insulation: Rigid cellular thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process, CFC-free, complying with ASTM C578, Type IV; with shiplap interlocking edges for additional air and moisture barrier protection; thicknesses as shown on the Contract Drawings.

2. NOT USED.

PART 3. EXECUTION

3.01 PREPARATION

A. Ensure that the foundation on which the wall is to be built has a clean, level surface free from laitance, other foreign materials, and frost or ice.

B. Verify that the foundation elevation is such that the masonry bed joint shall not vary more than 1/4 inch in 10 feet and that the foundation edge is true to line so that the masonry does not project over the edge more than 1/4 inch.

C. Clean projecting dowels and steel reinforcing to remove loose rust, scale, dirt, concrete or other material that will inhibit bond.

D. Verify that dowels and inserts for securing masonry to concrete and metal ties for securing masonry to structural steel are properly located and installed.

3.02 INSTALLATION

A. General

1. Comply with referenced unit masonry standard and other requirements indicated in this Section applicable to each type of installation included in this Contract.
2. Comply with construction site tolerances of referenced unit masonry standard.
3. Maintain uniform thickness of horizontal and vertical joints.
4. Use full-size units without cutting where possible. Where required to provide a continuous pattern or to fit to adjoining construction, cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges.
5. Cut units accurately to fit penetrations for plumbing, ducts, electrical, fire protection and communication Work, and patch holes neatly.
6. Use proper special shape units for windows, doors, bond beams, lintels, pilasters and corners with a minimum of unit cutting.

B. Laying CMU

1. Furnish and install concrete masonry units of the types and sizes shown on the Contract Drawings and which are dry, sound, clean and free from dust, dirt and cracks before laying.
2. Lay units plumb, level and true to line, with cells vertical.
3. Fully bed each concrete masonry unit in mortar with vertical joints completely filled and shove unit to a solid bearing.
4. Joint Size: Not more than 3/8 inch thick, except for PCMU which shall have 1/4 inch apparent joints.
5. Lay units in running bond pattern, unless otherwise shown on the Contract Drawings.
6. Point and tool joints in exposed concrete masonry units slightly concave with an approved jointing tool. Strike joints smooth and flush with a trowel at surfaces within wall cavity and at surfaces to be plastered, stuccoed, covered with masonry, paneling or gypsum board, or where resilient base is to be applied.
7. Where epoxy mortar joints are shown on the Contract Drawings, rake out setting mortar to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy mortar manufacturer's instructions.
8. Completely fill with mortar the hollow cores of concrete masonry units which support additional loads such as lintels, brackets, mechanical or electrical equipment, those adjacent to door frames and elsewhere where shown on the Contract Drawings. Unless units below are shown on the Contract Drawings to be filled also, install 1/4 inch square mesh grout screen to prevent grout from dripping into voids below.
9. Solidly grout longitudinal joints in two or more wythe masonry, except for cavity in cavity wall construction, if any.
10. Keep cavities clean of mortar droppings and other materials. Make provisions during laying up of cavity walls to permit the removal of mortar droppings and other debris that may fall into cavity.

11. Anchor concrete masonry unit walls to columns, beams, joists and similar structural members with anchor bolts or equivalent devices. Anchors shall be fully and solidly grouted in place. Embedment shall be not less than two-thirds of the wall thickness, unless otherwise shown on the Contract Drawings.

C. Installation of Miscellaneous Items

1. Install flashings and other sheet metal items to be incorporated in masonry as shown on the Contract Drawings, fully bedded in mortar above and below and overlapping a minimum of 4 inches at ends.

   a. Thru-wall flashing shall extend completely through wall, or shall terminate in a stainless steel drip edge.

2. Install anchor bolts, sleeves and other miscellaneous steel items to be incorporated in masonry in accordance with the Contract Drawings and approved Shop Drawings submitted under other Sections. Solidly fill spaces between such items and masonry with mortar and tool exposed joints.

D. Laying Sills and Copings

1. Set masonry sills and copings where shown on the Contract Drawings using anchors as recommended by the manufacturer in a manner so as not to affect the waterproofing integrity of the metal flashings underneath the sills and copings.

2. Install expansion joints at ends of sills and caulk joints where shown on the Contract Drawings and as specified in other Sections.

3. Install expansion joints in copings where shown on the Contract Drawings consisting of 1/2 inch joints for sealants as specified Division 7 Section on sealants.

E. Steel Reinforcing

1. If a foundation dowel does not line up with a vertical core, it shall be sloped not more than 1 inch horizontally per 6 inches vertically. Grout dowels within a core to a vertical alignment, even though it may be in a cell adjacent to the vertical wall reinforcing.

2. Where reinforcing bars are to be spliced, lap reinforcing bars by a minimum distance equivalent to 30 reinforcing bar diameters. Separate overlapping reinforcing bars by 1 bar diameter or wire together.

F. Horizontal Joint Reinforcement

1. Completely embed joint reinforcement in mortar or grout. Joints with wire reinforcement shall be a minimum of twice the thickness of the wire. Lap reinforcement 6 inches minimum at splices to contain at least one cross wire of each piece of reinforcement in the lapped area.

2. Cut or interrupt joint reinforcement at control and expansion joints.

3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" reinforcement sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns.

G. Install control and expansion joint materials in unit masonry as Work progresses. Offset control joints from expansion joints in wythes.

H. General Grouting

1. Placement Standard: Comply with ACI 530.1/ASCE 6/TMS 602 *Specifications for Masonry Structures*, including requirements for pour height.

2. Place grout only after entire height of masonry to be grouted has attained proper strength to resist grout pressure. Stop grout pour 1 inch from top of masonry unit so that next pour will be keyed in.

3. Steel reinforcing shall be in place before grouting begins.

4. Vibrate, rod or puddle grout in place.

5. Keep mortar droppings out of grout spaces.

6. Maintain vertical cell alignment to preserve a continuous unobstructed cell area not less than 2 inches by 3 inches.

7. Solidly fill with grout, cells containing steel reinforcing, bolts or other anchor devices and where shown on Contract Drawings.

8. Solidly fill spaces at metal door frames and other built-in items with grout or mortar.

I. Install cavity wall insulation where shown on the Contract Drawings using adhesive type as recommended by insulation manufacturer, compatible with dampproofing or air barrier, if any.

J. Patching

Point holes and defective mortar joints in exposed masonry. Where necessary, cut out and repoint defective joints in exposed masonry. Patching shall match adjoining masonry in quality and appearance.

K. Matching Existing Masonry: Match coursing, bond pattern, color and texture of new masonry with existing masonry.

3.03 FIELD QUALITY CONTROL

A. Place grout only after the Engineer has verified compliance of steel reinforcing grade, sizes and placement, anchorages and grout spaces with the requirements of the Section of the Specifications on steel reinforcement, as well as Contract Drawing requirements.

B. Verify compliance with compressive strength requirements of completed masonry, where shown on the Contract Drawings or as required by the Engineer.

3.04 CLEANING AND PROTECTION

A. Protect exposed masonry against staining from grouting or other sources and clean excess mortar off surfaces as the Work progresses.

B. Furnish temporary protection for door jambs and corners during the Work. Remove temporary protection when directed by the Engineer.

C. Upon completion of masonry construction, clean exposed masonry surfaces with stiff-bristled brushes and water so as to leave the masonry surfaces clean and free of mortar daubs.

D. If ordinary cleaning is not adequate, use special methods and materials to clean surfaces as approved by the Engineer.

END OF SECTION

SECTION 04220

CONCRETE MASONRY UNITS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

For each type of concrete masonry unit and accessory including certifications that each complies with specified requirements.

B. Shop Drawings

1. For concrete masonry units, showing sizes, profiles, coursing, bond pattern, special shape locations, joint locations and embedded items.
2. For cast stone trim in form of cutting and setting drawings, showing sizes, profiles and locations of each stone trim unit required.
3. For joint reinforcement and steel reinforcing. Detail fabrication, bending and placement of unit masonry reinforcing bars. Comply with ACI 315 showing reinforcing bar schedules, stirrup spacing, diagrams of bent bars and arrangement of masonry reinforcing.
4. Shop Drawings and/or manufacturer's catalog cuts of dovetail slots and other devices, if any, required for anchoring masonry to steel or other materials, including instructions for their proper use.

C. Samples

1. Samples for approval for each different type and shape of exposed masonry unit required, showing full range of exposed color, texture and dimensions to be expected in the finished Work. When required by 2.01 B.7, prefaced or ground face, submit concrete masonry unit samples for color selection or verification.
2. Two sample sections of cast stone sills and coping, if any, showing color and texture of finish.
3. Samples of accessories embedded in masonry.

D. Certifications

1. Test results from qualified testing lab, certifying that masonry complies with 1.05 F.
2. Galvanizing certifications for steel hardware showing compliance with ASTM A153.
3. Material test report for anchor bolts, wire ties and anchors

E. Construction and Installation Procedures

For Cold or Hot Weather: Detailed description of methods, materials and equipment to be used to comply with cold or hot weather requirements as applicable, evidencing compliance with specified requirements.

F. Qualifications

Qualification data for firms and persons specified in 1.05 to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, telephone numbers, names of Architects and Owners, and other information specified.

G. Quality Control Reports

Submit copies of reports verifying compressive strength requirements of completed masonry, if required by the Engineer, within 7 calendar days of the date of each completed test.

H. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein.

Sustainable Design submittals shall include the following.

1. *A completed Sustainable Design Materials Certification Form (SDMCF), appended* to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).
      2) The assembling location of the supplied product(s)
      3) The location (source) of the raw materials used to manufacture the supplied product(s).
      4) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.
2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.
4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).

5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 5

SECTION 05082

METALIZING OF STEEL MEMBERS

PART 1. GENERAL

1.01 SUMMARY

A. This specification covers the requirements for thermal spray metallic coating, with or without sealers or tip coats, as a means to prevent corrosion of steel surfaces.

B. Perform all shop metalizing in an enclosure which provides the required atmospheric conditions and prevents any exposure to inclement weather prior to the coating being completely cured.

C. Perform all work at the steel fabrication shop unless otherwise specified.

D. Follow the requirements outlined in the Society of Protective Coatings Guide for "Thermal Spray Metallic Coating Systems" (SSPC CS-Guide 23.00) and consider them as part of this specification.

1.02 REFERENCES

A. Society of Protective Coatings Guide for "Thermal Spray Metallic Coating Systems" (SSPC CS-Guide 23.00) and consider them as part of this specification.

B. Research Council on Structural Connections for "Specification for Structural Joints Using ASTM A325 or A490 Bolts"

1.03 RELATED SECTIONS

A.	Division 1	General Provisions
B.	Section 05120	Structural Steel

1.04 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified, the metallic coating to be applied shall be pure zinc, conforming to the requirements of ASTM B6.

B. Furnish a Certificate of Analysis for each lot of material supplied. Properly label each container or coil reel to identify component type, supplier, size, and wire lot number.

C. The size of wire material shall conform to the manufacturer's recommendations for the Arc Sprayed method.

D. The metalizing material shall satisfy the requirements for at least a Class B slip coefficient and creep resistant per Appendix A of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" by the Research Council on Structural Connections. The test results shall be provided to the Engineer by the Contractor prior to the start of work.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. Clean to a near-white metal cleaning standard, ensuring that the steel surface will be free of all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint, and other foreign matter. Surface finish and cleanliness shall be confirmed according to SSPC-VIS1 or visual inspection.

B. A profile of 3 to 5 mils is required. Angular blast media-Mineral and slag abrasives shall be selected and evaluated per SSPC-AB1, (aluminum oxide) recycled ferrous metallic abrasives per SSPC-AB2, steel grit per SSPC-AB3.

C. Hardened flame cut edges shall be ground with a disk wheel grinder to a smooth contour prior to abrasive blasting.

D. Measurements shall be taken using profile tape and a micrometer, as outlined in ASTM D4417. Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel/NACE Standard RP0287, Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.

3.02 APPLICATION OF METALLIC COATING

A. Ensure that the applied zinc metalizing thickness is an average of 10 to 12 mils (dependent on environment), with no individual reading less than 6 mils nor greater than 16 mils. Record each coated component using certified coating thickness calibration standards in accordance with SSPC PA2 standards. At least one layer of coating shall be applied within 4 hours of blasting and the final thickness within a maximum of 8 hours of the blasting.

B. Surfaces not intended to be metalized shall be suitably protected from the effects of the metalizing operations.

C. If rust bloom, blistering, or a degraded coating appears at any time during the application of the Thermal Spray Coating, the following process shall be followed:

1. Stop spraying
2. Mark off the unsatisfactorily sprayed area
3. Call the Thermal Spray Inspector/Foreman to observe and evaluate the error
4. Report the deficiency to the RE and record the deficiency
5. Repair the area by removing the Thermal Spray Coating, re-blast to a minimum nearwhite metal finish (SSPC-10 standard) and as specified anchor tooth profile depth
6. Recoat the area
7. Record the actions taken to resume the job

D. Apply zinc metalizing in the field to the field bolted connections.

3.03 ADHESION

A. Random adhesion testing shall be performed for each coated component, utilizing specified pull/off adhesion testing equipment, in accordance with ASTM D4541 standards.

B. Zinc adhesion = 600 psi

3.04 METALIZING EQUIPMENT

A. The metalizing equipment shall be set up, calibrated, and operated.

B. The wire feed method shall be push type system only.

C. The system shall be capable of operation at 1000 amps continuous duty cycle.

D. The system shall be able to operate remotely from the power supply unit for a distance up to 1,200 feet.

E. The wire feed unit and thermal spray gun shall be portable and capable of operating from a reach-all scaffolding, harness, sling, boat, or small barge location.

F. Power source must be separate from wire drive to meet containment safety requirements.

G. Metalizing should occur while substrate still meets specified standards. Care must be taken to avoid contamination with oils and dirt.

3.05 COMPRESSED AIR

A. Compressed air shall meet ASTM D4285, method for Indicating Oil or Water in Compressed Air. Utilize a compressed air system capable of delivery at the nozzle of 125 cfm at 120 psi. To minimize any contamination, use an oil/water separator on the airline. 120 psi of compressed air maintains the proper atomization of the molten wire, producing the optimum spray pattern.

3.06 QUALIFICAITONS

A. The contractor or subcontractor executing the metalizing work shall have a minimum of five (5) years of previous experience in providing surface preparation for metalizing and metalizing application services in the shop and field, and a minimum history of three (3) completed similar projects.

B. The thermal spray technician must have a minimum of one year of experience in the operation of thermal spray equipment and hold a certificate of satisfactory completion of training.

C. Documentation of prior experience for a "Thermal Spray Coating Inspector/Foreman" shall be available for review. Documentation shall consist of a minimum of four (4) separate project "Quality Assurance" sheets signed by the company "Thermal Spray Coating Inspector/Foreman" and customer representative.

3.07 QUALITY ASSURANCE PLAN

A. The Contractor shall provide a written quality assurance plan that will be submitted to the Engineer or contracting officer for approval. Such a plan shall include a method of adhesion testing, thickness measuring, bend test protocol, and MSDS sheets for material utilized on the projects. A micrograph study, performed by an independent laboratory, must be supplied with the QA Plan, depicting less than 10% porosity in the thermal spray coating.

3.08 SHIPPING AND HANDLING

A. All fully coated and cured assemblies shall be protected from handling and shipping damage with the prudent use of padded slings, dunnage, separators and tie downs. Loading procedures and sequences shall be designed to protect all coated surfaces. Any damaged areas shall be repaired in conformance with the manufacturer's recommendations or as directed by the Engineer.

3.09 REPAIRING DAMAGED COATING

A. Provide facilities to protect the finished metalized surface from damage during the blasting and thermal spraying work operations on adjacent areas. Repair damaged coatings as directed by the Engineer in conformance with the coater's recommendations. at no additional cost to the Authority.

END OF SECTION

SECTION 05082

METALIZING OF STEEL MEMBERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05082A01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, As-Builts, and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

05082B01 Catalog Cuts

Samples

05082C01 Samples

Product Data

05082D01 Product Data

Certificates

05082E01 Certificates

Manufacturer Test Reports

05082F01 Manufacturer Test Reports

Construction and Installation Procedures

05082G01 Construction and Installation Procedures

Calculations

05082H01 Calculations

05082I01 Manuals, Warrantees/Guarantees

END OF APPENDIX "A"

DIVISION 5

SECTION 05083

VMS OVERHEAD SPAN SUPPORT STRUCTURE

PART 1. GENERAL

1.01 SUMMARY

A. This work shall consist of the fabrication, furnishing and erection of overhead span sign support structures for the variable message signs (VMS) and assemblies in accordance with the contract documents. This work includes walkway gratings, handrails and posts, maintenance ladders, fencing, shims and any other miscellaneous hardware necessary to make a complete installation at each location.

B. This work also includes the reinforced concrete foundations and anchorages in accordance with the details shown in the Contract Plans.

C. This work shall also consist of the removal of existing overhead sign structures, attachments, foundations and conduits.

1.02 REFERENCES

A. New Jersey Turnpike Authority Standard Specifications, Sixth Edition, dated 2004, with current Standard Supplementary Specifications, addenda and modifications.

NOTE: In the various subsections of the NJTA Specification, or the NJDOT Standard Specifications referenced in this specification, references to "The Authority", or "The Department" or "NJDOT" shall be taken to mean The Port Authority of New York and New Jersey (the Authority).

References to "The Engineer", or "Chief Engineer" or "Resident Engineer" shall be taken to mean The Port Authority of New York and New Jersey (the Engineer).

B. New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction, dated 2007, with current additions and modifications.

C. American Association of State Highway and Traffic Officials (AASHTO) Standard Specifications for the Structural Support of Highway Signs, Luminaries and Traffic Signals 2009, 5th Edition with all current interims through 2012, and as modified herein these specifications and shown on the Contract Plans.

D. American Welding Society (AWS) – applicable AWS codes for all welding and welding inspection.

1.03 RELATED SECTIONS

A.	Section 02221	Excavation Backfilling and Filling
B.	Section 02378	Drilled Shafts
C.	Section 03200	Concrete Reinforcement
D.	Section 03301	Cast-in-Place Concrete

E. Section 05082 Metalizing of Steel Members

F. Section 05120 Structural Steel

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. The materials requirements of NJTA Standard Specifications Section 406 shall apply unless superseded by these plans and specifications.

B. HSS steel structural tubing shall conform to ASTM designation A709 Grade 50. Only one longitudinal seam will be permitted per tubular member.

C. All structural steel shapes and plates shall conform to the requirements of ASTM designation A709 Grade 50.

D. Steel surfaces shall be prevented from coming in contact with aluminum surfaces by means of approved stainless steel plates conforming to the requirements of ASTM A240 Type 304 or rubber impregnated random fiber pads conforming to the following, or approved equal:

1. Comcord as supplied by JVI, Inc., Skokie, IL
2. Fabco SA-47 as supplied by Fabreeka Products Company, Inc., Stoughton, MA
3. MR-10-RF as supplied by Tobi Engineering, Inc., Glenview, IL

E. Steel for Sign Structures and steel for component parts of sign structures shall meet the requirements of the NJTA Standard Specifications and the following:

All material greater than 1/2 inch thick shall meet the Charpy V-Notch toughness requirements AASHTO Standard Specifications for Structural Steel – Zone 2 (ASTM A370).. Chords, struts, end posts, base plates, and flange splice plates shall be considered main members. Diagonals, and gusset or tab plates shall be considered secondary members.

Upon receipt at the fabrication plant, all main member material shall be traceable to a mill test report and traceability shall be maintained throughout the duration of the fabrication.

All main member material thickness shall be a minimum of ¼ inch.

F. Unless noted otherwise the following material specifications shall apply:

Bolted connections with bolt diameters ½" or greater shall be ASTM A325X Type 3(threads excluded from the shear plane), nuts are ASTM A563 Type DH3, and washers are ASTM F436 Type 3.

Bolts specified less than ½" in diameter shall be Stainless Steel Type 18-8 or better with standard head capscrews, nuts are distorted thread 'top lock' locknuts, and washers are round hole with minimum thickness 0.059.

Thread locker shall be Loctite 2760 on all bolted connections (excluding anchor bolts)

Steel for walkway grating, expanded metal fence, access ladder, access door and all other appurtenances specified as galvanized either within the contract plans or specifications shall be hot dipped galvanized in accordance with ASTM A123. Bolts, nuts and washers shall galvanized be in accordance with ASTM A153.

G. Anchor bolts shall conform to ASTM F1554 Grade 105 (8 UN). Nuts shall conform to ASTM A563, and plate washers shall conform to ASTM A709 Grade 50. Bolts nuts and plate washers shall be galvanized in accordance with ASTM A153.

H. Structural aluminum shapes shall be non-welded aluminum alloy 6061-T6.

I. All stainless steel bolting material shall be ASTM A193, Grade B8.

J. The requirements of Specification Section 03301 shall apply for structural concrete.

K. The requirements of Specification Section 05082 shall apply for metalizing structural steel.

PART 3. EXECUTION

3.01 DRAWINGS

A. Shop, erection and other drawings necessary for the fabrication and erection shall be submitted for all overhead span sign support structures in the contract documents. The Contractor shall submit shop drawings in accordance with the requirements of Specification Division 1.

3.02 FABRICATION

A. All fabrication, inspection, transportation and erection shall be performed in accordance with the requirements of the NJTA Standard Specifications.

B. The following requirements shall apply:

1. Storage of Materials. Structural material shall be stored in a manner that will protect the materials from deformation, surface deterioration and accumulations of dirt, oil, or other foreign matter.
2. Straightening Materials. Prior to erection in the field all deformed structural materials shall be properly straightened by methods which are non-injurious. Sharp kinks and bends, and deep dents shall be cause for rejection.
3. High Strength Bolts. Each bolt shall be furnished with a flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight. Fasteners shall be inspected after installation in accordance with the NJTA Standard Specifications, and shall apply to a minimum of 10% of the connections randomly throughout the entire span of the structure. All holes for high strength bolts in main members shall be made in accordance with the NJTA Standard Specifications. This requirement also includes all secondary members that are welded to main members.
4. Quality. Fabricators shall be certified in accordance with the American Institute of Steel Construction's Quality Certification Program in the Simple Steel Bridge Structures Category, or an equivalent program acceptable to the Engineer.
5. Inspection. Provisions for shop inspection shall be in accordance with the NJTA Standard Specifications.

6. Assembly. All overhead span sign support structures shall be fully assembled in the fabrication shop to ensure proper fit-up.

7. Acceptance for Shipping. Each section of a sign structure shall bear the QA inspector's mark of acceptance prior to shipping.

3.03 TRANSPORTATION

A. Sign structures (including posts and post assemblies) shall be shipped by flat bed trailer or other similar means. Structures shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage from occurring during transportation. The use of any device which does not support the member for its entire length, as described below, shall not be permitted. This prohibition includes, but is not limited to, dolly wheels and pole trailers.

B. Adhering to these requirements does not relieve the Contractor of the responsibility for damage to the structure en route.

3.04 ERECTION OF OVERHEAD SIGN STRUCTURE

A. Methods and Equipment. Before starting work, the Contractor shall submit details of the method of erection, procedures and types of equipment he proposes to use, to the Engineer for review and approval. Approval shall not relieve the Contractor of the responsibility for the safety of the methods or equipment, or for damage to the structures due to overloading.

B. Prior to removing an existing sign structure or installing a new one, the Contractor shall submit details of the operation to the Engineer for approval at least 72 hours in advance.

C. The existing sign structures shall not be removed until they are no longer necessary. Any existing sign panels that conflict with a new traffic pattern shall immediately be removed from the sign structure and the sign illumination shall also be disconnected.

D. Existing sign structure foundations shall be removed to a depth of two (2) feet below the finished grade and backfilled. Removal of the sign structures and footings shall be performed with extreme care so as to avoid damage to the facilities of the Bayonne Bridge and to prevent any needless interference or delays to Bayonne Bridge patron traffic.

E. All demolished material becomes the property of the Contractor and shall be removed from the site and properly disposed of.

F. Handling and Storage. Structural members shall be loaded, moved, and unloaded in a manner that prevents stresses in excess of those provided for by the structure design. Permanent distortion, or other damage attributable to the Contractor's operations, shall be cause for rejection. Members stored either in the fabricator's storage area, or at the work site, or at other storage areas, shall be supported off the ground in a manner that will not allow distortion, or other damage to occur.

G. Lifting. Erection of overhead sign structures shall be done in accordance with the Authority's Specifications. Lift Plans are required, and shall be submitted to the Engineer for approval. Nylon slings, or an equivalent approved by the Engineer, shall be used for all lift operations. Picking points for the superstructure portion of span type overhead span sign support structures shall be made at the panel points that are closest to the third points of the span, in order to ensure that no members are overstressed during lift operations. Picking shall be made by wrapping the entire cross section of the structure.

H. When alternate pick points are used, the Contractor shall submit calculations which show that the proposed operation is safe and/or that the operation will not cause an overstress condition. The calculations and any supporting drawings or other information shall be signed and sealed by a Professional Engineer currently registered in the State of New Jersey. However, lifting by chains or by individual members shall not be permitted.

I. The Contractor shall obtain permit from the Authority for any operation during the erection of the overhead sign structures that requires road and/or lane closure.

J. Field Inspection. All sign structures shall be visibly inspected, and components shall be clean prior to erection. Damage that is attributable to the Contractor's operations shall be cause for rejection. Damage includes, but is not limited to, bends, kinks, dents, cracks and pits. Rejected structures, or components, shall be removed from the work site and repaired, or replaced as required by the Engineer. All work relating to the repair or replacement, of defective structures, or components, shall be done at no additional cost to the Authority.

K. Anchor Bolts. The following procedure shall be used for placing and tightening anchor bolts for on-grade foundations:

1. Anchor bolts shall be carefully set to the proper location, alignment, and elevation by using templates. Templates shall be as detailed in the contract documents, and shall be used at both the top and bottom of the anchor bolt pattern. Bottom templates shall be cast into the footing. Top templates shall be placed near the top of the anchor bolts so as not to interfere with concrete operations, and shall be left in place for 24 hours after concrete placement. Undamaged top templates may be reused. Please note that coordination of end frame anchor plate templates is required to ensure proper placement of the anchor bolts during foundation construction.

2. Anchor bolts shall be set vertical, within 2.5% out of plumb, and shall not be realigned by bending to fit the base plate. Anchor bolts that do not fit the base plate, or anchor bolts that are more than 2.5% out of plumb, shall be rejected. The Contractor may propose a remediation method for the rejected anchor bolts, subject to the approval of the Engineer. Rejected anchor bolts, and the concrete they are embedded in shall be replaced by new materials at no cost to the Authority.

3. The exposed portion of the anchor bolts shall be cleaned with a wire brush. The leveling nuts and washers under the base plate shall be threaded onto the anchor bolts, leaving a gap between the top of concrete and the bottom of the leveling nuts of no more than one anchor bolt diameter, and no less than 3/8 inch.

4. The post(s) alone, without the arms attached, shall be placed on the leveled anchor bolts and washers. Posts shall not be raked back to account for camber. The base plate shall bear directly and evenly on the washers and leveling nuts.

5. Beeswax, or the equivalent, shall be applied to the bearing face and the threads inside the top nut. The top anchor bolt nuts and washers shall then be placed and tightened by hand. All cleaning and lubricating shall be done immediately prior to nut placement and tightening. Top nuts and leveling nuts shall be checked for full bearing against the base plate, and any loose nuts shall be tightened by hand. The top nuts shall then be snug tightened using 20 - 30% of the torque values listed in Table 1 below. The snugging sequence shall be as shown on the contract drawings. The leveling nuts shall then be similarly checked for snug tightness, using 20 - 30% of the values listed in Table 1.

6. Fully tighten all top nuts according to the torques listed in Table1 below. There shall be no rotation of the leveling nut during this procedure.

7. An additional nut shall be installed and tightened against the top nut to lock the installation. This lock nut shall be prepared and tightened as defined in No.5 and No.6 above. There shall be no rotation of the lower top nut during this procedure.

TABLE 1- ANCHOR BOLTS

Anchor Bolt Size (inches)	Required Torque (±5%) (ft•lbs)
1 ½	650
1 ¾	1,000
2	1,500
2 ¼	2,200
2 ½	3,000

L. Bolting. Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of NJTA Specification Section 903, High Strength Bolts, Nuts and Washers. Each bolt shall be furnished with a flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. Any gaps between the faying surfaces after snug tightening shall be cause for rejection. Rejected components shall be replaced or repaired at no cost to the Authority.

M. Bolts shall not be fully tightened before tolerances are checked. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight. Fasteners shall be inspected after installation in accordance with AASHTO Standard Specifications.

N. Welding. Field welding shall not be permitted on any part of the structure, except as noted on the Contract Plans and approved by the Engineer.

O. Galvanized Metal Repair. Where limited areas of galvanized surfaces are damaged during shipping or erection, the Contractor shall repair by any of the three methods specified in ASTM A780. In all cases, the repair shall achieve the minimum coating thickness specified for the item, except that zinc paint applied by the spray method shall not be permitted.

END OF SECTION

SECTION 05083

VMS OVERHEAD SPAN SUPPORT STRUCTURE

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05083A01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, As-Builts, and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

05083B01 Catalog Cuts

Samples

05083C01 Samples

Product Data

05083D01 Product Data

Certificates

05083E01 Certificates

Manufacturer Test Reports

05083F01 Manufacturer Test Reports

Construction and Installation Procedures

05083G01 Construction and Installation Procedures

Calculations

05083H01 Calculations

05083I01 Manuals, Warrantees/Guarantees

END OF APPENDIX "A"

DIVISION 5

SECTION 05120

STRUCTURAL STEEL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for structural steel.

B. Related Work specified in other Sections of the Specifications includes the following:

1.	Grout (Non-Metallic)	Section 03602
2.	Intumescent Mastic Fireproofing	Section 07812
3.	Paint	Section 09910

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

LRFD Bridge Design Specifications, 6th Edition, 2012

LRFD Bridge Construction Specifications, 3rd Edition, 2010

Design Guide for Design of Pedestrian Bridges.

American Institute of Steel Construction (AISC)

Code of Standard Practice for Steel Buildings and Bridges:

Sections 2, 6, 8 and 10, only (except that all references to the responsibility of the Owner and the Engineer will not apply.)

Specifications for Structural Steel Buildings

Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts

Quality Certification Program

American Society for Non-destructive Testing (ASNT)

SNT-TC-1A	Recommended Practice

American Society for Testing and Materials (ASTM International)

ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM F436	Standard Specification for Hardened Steel Washers

American Welding Society, Inc. (AWS)

AWS D 1.1	Structural Welding Code, Steel
AWS D 1.5	AASHTO/AWS Bridge Welding Code
AWS QC1	Certification of Welding Inspectors

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Connection Design and Detailing

1. Complete details shall be shown on the shop drawings. For all Work, other than structural steel for bridges, the Contractor shall complete the design of connections for any portion of the structures not shown on the Contract Drawings or indicated in the Specifications.
2. For bridges, the design of connections for any portion of the structures not shown on the Contract Drawings or specified in the Specifications will be provided by the Engineer.
3. Design and detailing for any alternative connections proposed by the Contractor and accepted by the Engineer shall be prepared by the Contractor. All connection design and detailing prepared by the Contractor shall be performed under the supervision of a Professional Engineer licensed in the state where the steel is to be installed. The calculations and shop drawings shall also bear the signature and seal of a Professional Engineer licensed in the state where the steel is to be installed.
4. In the case of conflict between the requirements of this Contract and the Codes and Standards contained in the AASHTO or AISC publications referenced in 1.02, the requirements of this Contract shall govern.

B. Shop Drawings

1. The shop drawings shall contain all dimensional and geometric information. Materials shall not be ordered, fabricated, or delivered to the construction site before the shop drawings have been approved.
2. Prior to review of the shop drawings by the Engineer, such shop drawings shall have been reviewed and approved by the Contractor and shall be stamped to indicate this by the Contractor. Such approval by the Contractor shall constitute the Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and has reviewed or coordinated each shop drawing with other shop drawings and samples and with the requirements of the Work and the Contract Drawings and Specifications.
3. Shop drawings shall include layouts and details showing the type of steel for each member, sizes of members, connections, cuts, copes, cope reinforcing, bolts, welds and other pertinent data. Provisions for the connection of any other work shall be indicated on the shop drawings.
4. All welds shall be indicated by standard welding symbols as defined by AWS. Shop drawings shall show the size, length, and type of each weld.
5. Job standards for all typical connections for beams and girders, column splices, moment connections and wind bracing details shall be prepared by or under the supervision of a Professional Engineer, licensed in the state where the steel is to be installed and shall have the signature and seal of the Professional Engineer.

6. Shop drawings shall be submitted in complete packages so that individual parts and the assembled unit may be reviewed together. Index sheets shall be furnished with all beam, girder and column details at the same time the details are submitted for review.

7. The review of shop drawings by the Engineer shall not in any way relieve the Contractor from the responsibility for the adequacy of the design of the connections and all required detailing, the responsibility for the proper fitting of the Work in strict conformance with the Contractor requirements and from the necessity of furnishing material and workmanship required by Contract Drawings and Specifications in addition to that indicated on the shop drawings

8. The Contractor shall supply a complete set of stamped, approved drawings to the Authority Quality Assurance representative at the fabrication shop prior to the commencement of any fabrication.

C. Transportation Drawings: The Contractor shall provide calculations and transportation drawings to verify the structural integrity and stability of the structural steel members during transportation. The calculations and transportation drawings shall be signed and sealed by a Professional Engineer licensed in the state where the steel is to be installed and shall have the signature and seal of the Professional Engineer.

D. Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or bolts and other embedded items. All field-bolted connections, not specifically shown on shop drawings, shall be shown on erection drawings.

E. Erection Procedure and Work Plan: The Contractor shall propose the method of erection and shall provide a complete work plan including but not limited to; use of work trains, erection boom or other approved method, other rigging equipment and procedures, concrete mixing and placement, power requirements and source, and ventilation requirements, signed and sealed by a registered Professional Engineer licensed in the state where the steel is to be installed.

1.04 QUALITY CONTROL

A. Requirements

1. The entity performing the Work of this Section shall have a minimum of three years experience in structural steel work involving complexities similar to those required under this Contract and shall employ labor and supervisory personnel experienced in this type of Work.

2. When the total quantity of steel furnished under this contract exceeds 10 tons, the fabrication shop shall be certified under the AISC certification program as:

a. The AISC Building Quality Management System Certification:

(1) Category STD for standard (conventional) steel building structures.

b. The AISC Bridge Quality Management System Certification:

(1) Categories, as defined by the Bridge Checklists:

(a.) Category CBR (major steel bridges) for the arch structure,

(b.) Category F (fracture critical endorsement) for fabrication of fracture critical members which are designated on the Contract Drawings,

(c.) or a higher category, if shown on the Contract Drawings.

(2) Or Categories, as defined by the Bridge Standard in accordance with the AISC Certification Program for Steel Bridge Fabricators – Standard for Steel Bridges – 2011 (AISC 205-11):

(a.) Categories shall be equivalent to or above the requirement of Article 1.04.A.2.b.(1).

A list of certified fabrication shops for each Category can be found on the following website:

http://www.aisc.org/find/FindCertifiedCompany.aspx?id=5542

3. The Contractor's Quality Control Plan shall be submitted to the Engineer for review and approval. The Engineer may elect to inspect the fabrication shop to verify that the fabrication is performed in accordance with contract documents and that the shop is operated in accordance with the Quality Control Plan. At a minimum, the Quality Control Plan for fabrication shall address all the items listed in Appendix A, Part C.

B. The Contractor shall qualify welding processes and welding operators in accordance with the applicable AWS Welding Code and shall provide certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.

C. The Contractor shall maintain a Quality Control Program for both fabrication and erection of structural steel to assure that all installations conform to the requirements of the Contract Drawings and Specifications. The Quality Control Program shall conform to the AISC Code of Standard Practice for Steel Buildings and Bridges, as well as the requirements in this Section for both shop and field inspection and testing. The Contractor shall employ non-destructive testing personnel that meet ASNT SNT-TC-1A Level II qualifications and an AWS Certified Welding Inspector (CWI).

1. For bridge work where "Fracture Critical Members" are shown on the Contract Drawings, the Contractor shall satisfy the requirements of the Fracture Control Plan as defined in the current AASHTO/AWS D1.5 Bridge Welding Code, including the Charpy Impact notch toughness requirements for Zone 2.

D. High Strength Bolts

1. Each shipment shall be accompanied by a mill certification report that shows mill test results for the included production lots. The Engineer reserves the right to sample and test bolts from any shipment.

2. Bolts may be sampled by the Engineer on site and tested by the Authority for wedge tensile and Rockwell hardness requirements in accordance with the appropriate American Society for Testing and Materials (ASTM) specifications. If any samples do not meet the test requirements, then the corresponding lot of bolts shall be rejected for use. Any bolts already installed from a failed lot or heat number shall be removed and replaced at no additional cost to the Authority.

3. Sampling shall be performed using the "shipping lot method" in which the ASTM specified number of bolts shall be taken from each shipment of the same nominal bolt size and length. Bolt containers shall be clearly marked with the manufacturer's name, the production lot number, and the heat number of steel. After sampling, as indicated in 1.04 D.2., the containers shall be so labeled in a manner approved by the Engineer.

4. All bolts used for bridge construction and all galvanized bolts shall also meet the requirements for rotational capacity testing as specified in the appropriate AASHTO/ASTM specification (e.g. ASTM A325, ASTM A490, AASHTO LRFD Bridge Construction Specifications Section 11.5.6.4.2).

E. In addition to performing field inspection, the Contractor shall inspect structural steel at the fabricating shop.

F. Welds shall be inspected and tested at the fabricating shop by the Contractor in accordance with AWS D1.1 (AWS D 1.5 for bridge members including catwalks and railings) and as follows:

1. All welds shall be visually inspected by an AWS Certified Welding Inspector (CWI). The contractor shall supply CWI coverage during all hours when welding is in progress.
2. All full penetration welds shall be non-destructively tested for 100 percent of the weld length by radiographic or ultrasonic methods, as approved by the Engineer, unless otherwise noted.
3. Areas of suspected defects found visually in partial penetration and fillet welds shall be non-destructively tested by magnetic particle or dye penetrant methods, as approved by the Engineer. However, for bridge members, test a minimum of 10 percent of the length of all partial penetration and fillet welds in accordance with AWS D1.5. If, in the opinion of the Engineer, the test results disclose unacceptable welds, then the percentage of welds required to be tested may be increased, as deemed necessary by the Engineer, up to 100%, without additional compensation.

G. The Contractor shall have sole responsibility for coordinating the Work and notifying the Engineer in a timely manner to assure that all testing and inspection procedures required by the Engineer are properly provided.

H. The Authority will perform Quality Assurance testing to ensure quality workmanship. Inspection and testing will include, but not be limited to, visual inspections, ultrasonic, radiographic, magnetic particle or dye penetrant testing of the welding and cutting performed in the fabrication shop and in the field. The percentage and extent of testing will be no less than 25% of that required of the Contractor. The Contractor shall notify the Engineer and the Authority Materials Engineering Division 15 days prior to the start of fabrication. Less than 1% of all High Strength Steel will be sampled for mechanical property testing by The Authority. Prior notice will be provided based upon the submitted mill order.

I. The Contractor shall supply equipment and personnel, at no additional cost to the Authority, to assist in moving members as necessary for adequate access to properly perform Quality Assurance inspections and testing by the Authority. Coupons of material may also be requested and shall be cut in the presence of the Engineer at no additional cost to the Authority. The Contractor shall also provide a desk and adequate workspace for the Authority shop inspector. Access to the use of telephones, fax machines and copy machines shall be provided at all times. The contractor shall supply high speed internet access for the QA inspectors

1.05 SHIPPING

A. All material that has been inspected and accepted by the Authority's Quality Assurance shop inspector will be stamped with the initials "PA" and a number near its piece mark. A stamped shipment report will also be provided and shall accompany each shipment. Any material that is shipped to the jobsite that is not stamped or included on the shipment report and noted as "Accepted" on said shipment report shall immediately be rejected by the Engineer and shall not be permitted to be unloaded at the jobsite. Application of the inspector's stamp does not imply that the material will not be rejected by the Authority if subsequently found to be damaged or defective.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the construction site at appropriate intervals so as to ensure uninterrupted progress of Work.

B. Material shall be stored in an area designated or approved by the Engineer. Structural steel shall be drained properly. Adequate shoring and protection shall be provided to prevent distortion and other damage. Structural steel shall be stored on timber and not on mud or cinders, and otherwise handled so as not to damage shop paint. All sections which are to be placed in ground storage shall be readily accessible for inspection.

1.07 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Structural Steel: Structural steel shall mean structural steel as defined in Section 2 - Classification of Materials of the AISC "Code of Standard Practice for Steel Buildings and Bridges". Structural steel shall conform to types shown on the Contract Drawings. The types are indicated by the ASTM or AASHTO designation for each. Each type shall conform to all of the requirements of the indicated ASTM or AASHTO specifications.

B. High Strength Bolts: High strength bolts, nuts and washers shall be of the types shown on the Contract Drawings. Joints using high strength bolts shall conform to the provisions of the AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts". In the case of bridge Work, conform to AASHTO LRFD Bridge Design Specifications Section 6.4.3 and AASHTO LRFD Bridge Construction Specifications Section 11.5.6.

1. Bolts conforming to ASTM A325 shall be mechanically galvanized.
2. Bolts conforming to ASTM A490 shall not be galvanized.
3. All connections using A325 and A490 bolts are to be considered "slip critical" unless noted otherwise on the Contract Drawings.
4. All connected surfaces are slip critical unless noted otherwise in the Contract Documents
5. All A325 and A490 bolts have threads included in the shear plane(s) unless noted other wise on the Contract Drawings.

C. Anchor Bolts: Anchor bolts shall conform to ASTM type shown on the Contract Drawings and shall be the regular hexagon-bolt type.

D. Welding Electrodes: Comply with AWS D1.1 (D1.5 for bridge members).

E. Grout: In accordance with Section 03602 of the specifications entitled Grout (Non-Metallic).

F. Intumescent Mastic Fireproofing: In accordance with Section 07812 of the specifications entitled Intumescent Mastic Fireproofing.

G. Paint: In accordance with Section 09910 of the specifications entitled Painting and Section 09913 entitled Paint Removal and Repainting Metal Fabrications.

H. Galvanizing: Elements to be galvanized are shown on the Contract Drawings.

1. Structural Steel: ASTM A123
2. Hardware: ASTM A153

I. Stud shear connectors: Stud shear connectors shall conform to ASTM type shown on the Contract Drawings.

2.02 FABRICATION

A. Fabrication shall not begin without approvals for the following:

1. Shop Drawings
2. Quality Control Plan
3. Welding Procedure Specifications
4. Procedure Qualification Records (if applicable)
5. Welder Qualifications
6. Mill Test Reports
7. Quality Control personnel, including an AWS Certified Welding Inspector (CWI), and non-destructive testing personnel that meet ASNT SNT-TC-1A Level II qualifications.
8. Transportation and Erection Procedures and Work Plan: Any fabrication performed without prior approval of these items shall not be accepted. In addition, a copy of all signed approvals, including the supporting documentation; shall be in the possession of the fabrication shop prior to the commencement of fabrication and shall be made available to the Authority's Quality Assurance inspector at all times.

B. Fabricate and assemble structural assemblies in shop to greatest extent possible. Provide camber and fabricate items of structural steel in accordance with the standards and specifications referenced herein and as indicated on shop drawings approved by the Engineer.

C. Properly mark and match-mark materials for field assembly. Fabricate for a delivery sequence, which will expedite erection and minimize field handling of materials.

D. Where finishing is required, complete assembly, including welding of units, before the start of finishing operations. Provide finish surfaces of members, exposed in final structure, free of markings, burrs, and other defects.

E. For bridge members the following shall be in accordance with Section 11 of the AASHTO LRFD Bridge Construction Specifications:

1. Workmanship, methods, standards, and accuracy of fabrication.
2. Fitting, cutting, drilling, punching, reaming, bending, curving, finishing, straightening, and cambering of steel.
3. Preparation, shop assembly, fitting and correction for misfits of connections.

PART 3. EXECUTION

3.01 PREPARATION

A. Work Under Other Sections: Examine all Work prepared under other Sections of these Specifications to incorporate the Work of this Section and ensure any defects affecting installation are corrected. Prior to commencement of the Work under this Section, verify the dimensions and coordinate the structural steel Work with Work under other Sections.

B. Anchor Bolts: The Contractor shall ascertain by accurate survey the location, alignment and elevation of the anchor bolts embedded in the concrete under other Sections, at least 21 working days prior to the start of the structural steel erection. Any discrepancy between the Contract Drawings and Specifications and the as-built conditions shall be corrected, as approved by the Engineer, prior to the start of steel erection.

3.02 ERECTION

A. Workmanship: All Work shall be erected plumb, square and true to lines and levels in strict accordance with Contract requirements and within tolerances of the AISC "Code of Standard Practice for Steel Buildings and Bridges" and in the case of bridges in accordance with AASHTO Specifications.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete Work.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances or more stringent tolerances when shown on the Contract Drawings. Establish required leveling and plumbing measurements at mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature of structure when completed and in service.

E. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting in accordance with Section 09910 of the Contract specifications entitled "Painting".

F. Bolting with high strength bolts shall conform with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts, or in the case of bridge work, AASHTO LRFD Bridge Construction Specifications, Section 11.5.6.

G. Grouting shall be performed in accordance with section 03602 of the specifications entitled Grout (Non-Metallic).

H. Galvanizing: Where shown on the Contract Drawings, in accordance with ASTM A123 for Structural Steel, ASTM A153 for bolts conforming to ASTM A307.

1. ASTM A325 bolts shall be mechanically galvanized.

2. ASTM A490 bolts shall not be galvanized.

I. Stud shear connectors shall conform to AASHTO LRFD Bridge Construction Specifications, Section 11.3.3.

J. Field Welding: Field welding to any member of the existing arch structure is prohibited.

3.03 FIELD TESTS

A. The Contractor shall perform inspections of the following items in accordance with the Codes and Standards contained in the AASHTO or AISC publications referenced in 1.02: connections; proper tensioning of bolts ; levels, plumbness and alignment of the framing; and field painting.

B. Field welding shall be inspected and tested by the Contractor in accordance with 1.04.F and the Contractor's Quality Control Plan for erection.

C. The Authority will perform Quality Assurance testing for field connections and welds in accordance with 1.04 H. The Contractor shall supply equipment and personnel needed to allow access for said testing, at no additional cost to the Authority.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. As per AASHTO LRFD Bridge Construction Specifications, "Shop Drawings, Catalog Cuts and Samples."
2. Connection Design and Detailing as per 1.03 A. prior to submitting job standards.
3. Job standards as per 1.03 B.5. prior to submitting detailed shop drawings.
4. Prior to the commencement of fabrication, approval of:
   a. Shop drawings for all structural steel as per 1.03 B.
   b. Transportation drawings as per 1.03 C.
   c. Erection drawings as per 1.03 D.

B. Erection Procedure and Work Plan

C. Catalog Cuts, Material Certification, Welder Qualifications, Welding Procedure Specifications and Test Results

1. As per AASHTO LRFD Bridge Construction Specifications, "Shop Drawings, Catalog Cuts and Samples."
2. Catalog cuts and manufacturer's literature on paint and grout specified under this section.
3. Prior to commencing with fabrication of steel; certified copies of all mill reports covering the chemical and physical properties of all steel used in this Contract shall be submitted. Such certification shall be obtained from the mills producing the steel and shall certify that the steel meets the minimum requirements as to physical properties, inspection, marking, and tests for structural steel as defined by the American Society for Testing and Materials (ASTM) or in the case of bridges, AASHTO, for the type of steel shown on the Contract Drawings.
4. Prior to commencing fabrication, mill certificates for high strength bolts as described in 1.04 D.1.
5. For bridge steel, submit results of Charpy Impact notch toughness tests showing suitability for use in zone 2 as defined in AASHTO prior to commencing fabrication.
6. Inspection and test results from fabrication shop as per 1.04 F within five calendar days of inspections and tests.
7. Inspection and test results from field tests as per 3.03 within five calendar days of inspections and tests.
8. Prior to commencing with fabrication of steel, welder qualifications and welding procedure specifications in accordance with 1.04 B.

D. Quality Control Documents

1. Copy of the fabrication shop's Quality Control Program as outlined in 1.04 C. The program, at a minimum, shall include the following:

   a. A copy of AISC certification for the fabrication shop indicating the required Category as specified.

   b. Organizational chart indicating specific names and titles of personnel clearly identifying the reporting structure of personnel and the qualifications of the individuals responsible for implementing the program.

   c. Material traceability, indicating the procedure used to identify each individual piece mark and its components that can be traced to a specific heat number on mill test reports.

   d. A procedure for handling nonconformance issues, including a sample worksheet for recording nonconformance issues. Include the name and title of the person responsible for final acceptance.

   e. The certifications and qualifications for an AWS Certified Welding Inspector (CWI), Non-Destructive testing personnel qualified to ASNT SNT-TC-1A Level II requirements, and their respective employers. Include samples of inspection and testing forms to be used for the work of this Contract.

   f. A detailed schedule for the duration of fabrication at each shop. The schedule shall show, at a minimum, the start and end dates for ordering material, cutting material, fabricating material, painting material, and shipping material. If the schedule changes, a revised schedule shall be submitted For Information Only.

   g. A brief statement that explains the amount of steel, in tons, the shop is fabricating and the application(s) the fabrication is intended.

2. Copy of the Fracture Control Plan as per 1.04 C, if applicable.

3. Name and location of shop that will perform painting work along with the shop's Quality Control Plan in accordance with Section 09910 entitled "Painting".

4. Notification, in writing, 15 days prior to commencing fabrication of structural steel.

5. Notification, in writing, 15 days prior to commencing with surface preparation and painting.

6. Notification, in writing, 15 days prior to commencing field welding operations.

E. Design Computations

1. Calculations for connection design and detailing shall accompany submittal A.2. in this appendix.

2. Computations for job standards shall accompany submittal A.3. in this appendix.

END OF APPENDIX "A"

DIVISION 5

SECTION 05125

ARCH RECONSTRUCTION WORK

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the repair, strengthening and altering of the existing steel arch structure and the construction of a roadway floor system at a higher elevation. The work also includes:

1. The construction of the Tower Structures (North and South) including the concrete pedestals anchored to the existing arch abutments.
2. The removal of lead paint.
3. Repainting of the arch members that remain.

B. The work specifically includes:

1. Lead abatement of existing arch members to remain
2. Painting
   a. Repainting of arch members to remain
   b. Painting of steel furnished and installed under this contract
3. Repair work:
   a. Removal of pack rust, cleaning and caulking of disturbed edges
   b. Replacement of deteriorated rivets, plates and shapes
4. Strengthening
   a. Arch box members with supplemental plates installed using the "cheese" plate method,
      (1) Rivet removal and replacement
      (2) Field drilling, reaming and drifting of holes for new high strength bolts in existing riveted members
   b. Existing floorbeams to remain in place by the addition of steel sections,
   c. Conversion of latticed members to box members.
5. Additions
   a. New tower structures including electrical floors
   b. Vertical column extensions for the non-suspended portions of the arch
   c. Lateral bracing for arch frames (at existing portals)
   d. Permanent and temporary suspender strand for floor support
   e. Floor system including edge girders, floorbeams, stringers, diaphragms, lateral bracing and light weight concrete deck
   f. West side access catwalk (concrete and grating)
   g. East side combined Shared Use Path (SUP) and utility gallery
   h. Support plates for upper suspender gussets

i. Concrete median and roadway barriers
j. Railings for SUP and west catwalk
k. Fire Standpipe system
l. Closed drainage system
m. Roadway/SUP lighting System
n. Navigation lights
o. Aviation lights
p. Aesthetic lighting
q. Electrical/Electronics conduits
r. Pilot's flag
s. Emergency telephones
t. Signs and sign structures
u. NOAA Air gap sensor

6. Removal
   a. Lead paint
   b. Suspender gussets
   c. Portions of existing floor system including:
      (1) Suspended floorbeams
      (2) Suspenders (wire rope)
      (3) Stringers and diaphragms
      (4) Existing deck slab
      (5) Floor system lateral bracing
      (6) Miscellaneous floor framing
      (7) Sidewalk (West side)
   d. Navigation lights
   e. Aviation lights
   f. Sway bracing
   g. Existing portal members
   h. Existing Tower structures including the electrical floor supported by the Tower structures.
   i. Roadway Lighting System
   j. Existing electrical and fiber optic conduit
   k. NOAA Air gap sensor

C. Related Work specified in other Sections of the Specifications includes the following:

1.	Bridge Drainage System	Section 02639
2.	Disposal of Spent Abrasive and Paint and Coating Material	Section 02899
3.	Concrete Reinforcing	Section 03200
4.	Portland Cement Concrete	Section 03301
5.	Structural Steel	Section 05120
6.	Bridge Suspenders (Strand)	Section 05156

7.	Half Filled Grid Deck	Section 05350
8.	Painting	Section 09910
9.	Paint Removal and Repainting Metal Fabrications	Section 09913
10.	Disc Bearings	Section 13086
11.	Smart Bridge	Section 13550

D. Access: Provide safe access to all parts of the work to allow a complete and detailed inspection.

1. Access to the interior of the arch chord box members will be required for the removal of rivets and installation of new bolts. This is a confined space and the interior surfaces are painted with red lead paint. It is to be treated as a confined space with respect to health and safety matters. All applicable confined space entry work is to be done in accordance with OSHA rules and regulations.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

LRFD Bridge Construction Specifications, 3rd Edition

American Society for Testing and Materials (ASTM International)

ASTM	*Standard Specification for:*
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM	*Standard Test Method for:*
ASTM E8	Tension Testing of Metallic Materials
	The Society for Protective Coatings
SP11	Power Tool Cleaning to Bare Metal
Technology Guide No. 5	Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. The requirements and responsibilities for the Contractor's structural analysis of the arch for construction loadings and sequences is included in Division 1 – General Provisions.

B. General: The intent of the Work is to achieve the profile of the roadway and the vertical clearances shown on the Contract Drawings after all construction is completed. The profile and elevations shown are for an ambient temperature of 60° F.

1. The arch structure moves vertically under temperature changes and the application of permanent and construction loads.
2. The plans define the final elevation geometry at completion of construction.
3. Consider temperature at the time of erection in the fabrication and erection of arch members and suspenders.

a. Erection elevations are a function of temperature and variable load deflections during construction.

b. Fabrication dimensions are a function of final load deflections and are independent of temperature variations during construction.

C. Arch Survey - Global

1. Perform a survey of the arch in three dimensions. The survey shall be tied to the state plane coordinate systems.

2. Key locations for control are shown on the Contract Drawings. These locations are to be surveyed before and after each key step of the construction process as specified hereinafter.

3. Record the ambient temperature for each survey conducted.

4. Conduct surveys within one hour of sunrise to minimize temperature gradient effects on the structure.

5. Provide a detailed survey procedure including methods, tolerances, Quality control, equipment and qualifications of survey personnel to the Engineer for review and approval.

D. Arch Survey - Detailed

1. The strengthening of members and the inclusion of new elements requires a high degree of accuracy in locating existing rivets and defining the relationship of those rivets to existing and proposed members. The "cheese" plate method of strengthening will require the pre-drilling of holes in a plate that will fit over existing rivets.

2. Perform a local survey of the locations where cheese plates are to be used. Use this survey as the basis for locating the holes in the cheese plates as well as the ties to existing members.

a. To minimize effects due to ambient temperature, the proposed location on the structure and the cheese plate should be surveyed at approximately the same time of the day.

b. Correct potential misalignments of holes prior to transport to the structure. Accuracies for this type procedure is +/- 1/16 of an inch.

3. New Portals: Survey the area of the work required for the construction at the new portals. Perform localized surveys of critical members prior to their removal including the adjacent members on the structure. Develop base drawings from the survey results.

4. Provide a detailed survey procedure including methods, tolerances, Quality Control, equipment and qualifications of survey personnel to the Engineer for review and approval.

5. Provide all dimensional and geometric information on the shop drawings. Do not order, fabricate, or deliver materials to the construction site before the shop drawings have been approved.

E. Geometry Control Plan

1. The Contract Drawings contain a detailed sequence for the reconstruction of the arch structure upon which strengthenings are based. The Contractor may propose an alternative sequence which will be evaluated by the Authority. No additional payment however will be made by the Authority for additional materials and work arising from a modified sequence.

a. Strengthen all elements of the existing arch structure prior to the construction of any component of the elevated floor system.

2. In conjunction with the detailed Work Plan required in Section 05120 - 1.03.D, provide a detailed, step by step tabulation of elevations for key points along the arch – both sides.

3. Major elements of work (not necessarily in chronological order) for which a line of elevation data is to be provided in the master table include:

   a. Removal of sidewalk and existing strengthening girders,

   b. Partial demolition of existing roadway and installation of temporary traffic barriers,

   c. Addition of containment units for lead abatement,

   d. Removal of containment units

   e. Work at new portal locations (addition, removal and strengthening of members),

   f. Strengthening of members on a panel point basis,

   g. Erection of new floorbeams,

   h. Erection of new stringers, diaphragms and bracings on a per panel basis,

   i. Partial construction of new arch deck at the upper level (initial and final),

   j. Construction of barriers on the upper level,

   k. Construction of new edge girders,

   l. Construction of the SUP structure,

   m. Construction of the SUP top slab,

   n. Construction of the SUP barriers,

   o. Construction of the west catwalk slab/grating,

   p. Removal of the remainder of the existing arch deck,

   q. Construction of final barriers (steel or concrete),

   r. Construction of drainage system, light poles, emergency telephone poles, electrical/electronics conduits.

4. Survey key points before and after each major operation occurs. Submit results to the Engineer.

5. Upon completion of construction provide a final survey along with a plan for making final adjustments to suspender lengths for the purpose of achieving the profile grade specified on the Contract Drawings.

6. Sign and seal the Geometry Control Plan by a registered professional engineer licensed in the states of New York and New Jersey.

F. Analysis, design and detailing of temporary bracing systems shown on the Contract Drawings are the responsibility of the Contractor. Design loadings for the temporary bracing system will be provided by the Authority after the Contractor's Means & Methods are submitted and approved. The Contractor shall submit design and details of the temporary bracing system to the Engineer for approval. The temporary bracing design and drawings shall be sealed by a Professional Engineer licensed in the states of New York and New Jersey.

G. Transportation Drawings: Provide calculations and transportation drawings to verify the structural integrity and stability of the girders during transportation. Sign and seal the calculations and transportation drawings by a Professional Engineer licensed in the states of New York and New Jersey.

1.04 QUALITY CONTROL

A. Include surveying operations in the Quality Control Plan prior to submitting to the Engineer for review and approval.

B. Sole responsibility for coordinating the Work and notifying the Engineer in a timely manner to assure that all testing and inspection procedures required by the Engineer are properly provided rests with the Contractor.

C. All surveys may be independently verified by the Engineer.

1.05 SUBMITTALS

A. See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

A. Structural Steel & Connectors - see Specification Section 05120

PART 3. EXECUTION

3.01 PREPARATION

A. Work Under Other Sections: Examine all Work prepared under other Sections of these Specifications to incorporate the Work of this Section and ensure any defects affecting installation are corrected. Prior to commencement of the Work under this Section, verify the dimensions and coordinate the structural steel Work with Work under other Sections.

3:02 ERECTION

A. General: Prior to the start of any repair and/or strengthening work in the field, remove lead paint and provide the prime coat as specified in Sections 09913 for System S-1.

1. A portion of the arch structure has had the lead paint removed and replaced with a three coat paint system. Where steel plates attached with bolted connections are furnished and installed, the paint system shall be cleaned to base metal. The limits of this abatement/repainting are shown on the Contract Drawings.
2. For other areas of the arch structure, the strengthening, repairs and modifications may be accomplished without removal of the prime coat that is applied after the lead paint has been removed.
3. The Contractor shall restore all existing paint systems damaged during the strengthening, modification and repair process.

B. Temporary Shoring and Bracing

1. The Contract Drawings provide temporary bracing members and sequences which are a requirement of the design.

2. Additional shoring and bracing members may be proposed along with connections of sufficient strength to bear imposed loads provided:
   a. The design and drawings are signed and sealed by a registered Professional Engineer licensed in the states of New York and New Jersey.
   b. They produce no adverse effects on the arch structure as determined by the Engineer.
3. Remove temporary members and connections when permanent members are in place and final connections are made.

C. Temporary Planking
1. Provide temporary planking and working platforms as necessary to effectively complete Work.

D. Installing New Members
1. Set structural members accurately to lines and elevations indicated. Align and adjust various members forming part of a complete frame or structure before permanently fastening.
2. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly except that the prime coat does not need to be removed.
3. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
4. Level and plumb individual members of the structure within specified AISC tolerances or more stringent tolerances when shown on the Contract Drawings.
5. Establish required leveling and plumbing measurements at mean operating temperature of the structure which is 60 deg. F.
6. Make allowances for difference between temperature at time of erection and mean temperature of structure when completed and in service.

E. Strengthening Existing Members
1. The Work is defined as the addition of solid plates using high strength bolts and the replacement of rivets with high strength bolts.
2. Replacement of Lattice Plates: At locations noted on the Contract Drawings, replace lattice plates with a solid plate or new lattice plates in accordance with the procedure shown on the Contract Drawings.
3. Replacement of Rivets: At locations shown on the Contract Drawings or as directed by the Engineer, replace rivets with high strength bolts in accordance with the provisions of this section. Rivet replacement may be for reasons of being defective (corroded) or for strengthening existing connections. Rivet or bolt replacement not identified on the Contract Drawings will be treated as Net Cost work.

F. Removal & Replacement of Rivets, Fasteners
1. General: Removing existing fasteners, reaming existing fastener holes, furnishing fasteners, washers, and nut assemblies for replacement of the removed existing fastener and installing new fasteners and field drilling through existing fasteners and installing new fasteners and shall conform to the Contract Drawings and these Special Provisions.

2. Existing fasteners consist mainly of rivets although some rivets have been replaced with bolts in the past. The terms "existing fasteners" and "existing rivets" are used interchangeably on the Contract Drawings and shall be understood as describing existing connections consisting of rivets and bolts as some of the original rivets have been replaced with bolts due to repairs and upgrades.
3. Verify all existing field conditions involved in the work and resolve all field conflicts in advance of submitting working drawings. Refer to Section 1.03.C for survey requirements for strengthening plate work.
4. Replace existing rivets with high strength bolts of the size shown on the Contract Drawings.
5. Remove and replace rivets one at a time unless otherwise shown on the Contract Drawings or directed by the Engineer.
6. Remove rivets in a manner so as not to damage the underlying connected material. Repair all damage resulting from Contractor's operations to the satisfaction of the Engineer at no additional cost to the Authority.
7. Remove rivets by one of the following methods:
   a. Shear rivet head using pneumatic rivet breaker (Helldog), and drive out rivet shank with a pneumatic punch.
   b. If, in the Engineer's opinion, punching will damage the base metal, or if there is insufficient clearance for use of a Helldog, remove rivet by drilling through the head and shank. Method of drilling shall be approved by the Engineer prior to rivet removal.
8. Install high strength bolts after all nicks, burrs and foreign substances that might interfere with seating of the bolt head, nut and washers are removed.
   a. If the bolt will not fit the rivet hole, the hole may be reamed sufficiently to accommodate the bolt, as approved by the Engineer.
9. Where oversized or elongated holes exist after removal of a rivet, the Engineer will check for minimum edge distance, pitch and gage in order to determine the installation procedure. Upon removal of each rivet, the base metal around the hole shall be examined for surface irregularities and deterioration in order to determine a replacement procedure.
   a. Where rivet hole diameters are increased by removal of oxidized materials or removal of corrosion, the diameter of the resultant hole may not be more than 1/16 inch larger than that of the matching high strength bolt.
   b. Where the size of the resultant hole above is exceeded, or where oversized or distorted holes are encountered upon rivet removal, notify the Engineer. In such cases the Contractor may be directed to ream the hole larger to install the next larger diameter bolt. Otherwise, the installation procedure will be determined by the Engineer.
   c. Do not enlarge holes by burning or by use of drift pins except as noted below for permissible drifting.
   d. Take all necessary field measurements to determine proper diameter and grip lengths of high strength bolts to be used.
10. Replace rivets removed under this Contract with ASTM A325 bolts.

11. Achieve bolt tensioning for ASTM A325 bolts by the calibrated wrench tightening method as specified in AASHTO - Division II Construction, Section 11.5.6.4.5, Calibrated Wrench Installation Method.

G. Field Drilling, Reaming and Drifting Of Holes

1. Clearly indicate the method of preparing holes on the shop drawings. Alternative methods to those presented in this Section may be proposed subject to the approval of the Engineer.

2. Drilling New Steel

a. When bolt holes in new repair or strengthening material are required to match an existing rivet/bolt pattern, prepare the work by creating a pattern of the existing rivet holes using a laser based survey. Use this pattern to drill one-quarter (1/4) inch sub-size holes in the new steel in the shop.

b. Thereafter, ream these holes to full size in the field using the existing steel component and its associated holes as a one time template.

3. Field Drilling Existing Steel

a. When new bolts are required in existing material, prepare in the field using one of the following methods:

(1) Drill full size holes using holes in new material as a one time template.

(2) Drill full size holes using a steel template with hardened bushings.

4. Field Reaming and Drifting of Holes

a. Field reaming and drifting of holes will be required when holes in the existing plies do not line up.

b. After reaming, holes to be perpendicular to the faying surface and 75% of the group of holes shall not be elongated greater than one-thirty second (1/32) inch. The remaining 25% of the group shall not be elongated greater than one-sixteenth (1/16) inch. If any bolt hole, after reaming, is more than one-eighth (1/8) inch larger than the nominal size of the bolt indicated on the drawings, use the next size bolt.

c. Notify the Engineer for approval should oversized bolts be required.

H. Removal of Existing Members

1. Suspender Gussets: For suspender rope gussets no longer needed in the final structure (Panel Points L6 to L9), and after removal of the existing wire rope suspenders in Stage 4, strike a chalk line along the lower edge of the lower clip angle of the suspender gusset on both sides of the lower chord.

a. Cut the existing gusset plate with an abrasion wheel power tool. Flame cutting is not permitted.

(1) Grind the edges of the cut plate to a smooth finish. The resulting plate shall be free of nicks, burrs and sharp edges.

2. Suspender Rope Anchorages (Lower Chord):

a. Remove rivets (bolts) from the suspender rope anchorage assembly in accordance with the provisions of this section.

b. Remove the suspender rope anchorage assembly.

c. Clean the area to bare metal in accordance with the provisions of Section 09913 entitled "Paint Removal and Repainting Metal Fabrications".

d. Abandoned Anchorage Locations: Install high strength bolts in open rivet holes in accordance with the provisions of this section.

e. New Anchorage Locations: Install new anchorages and bolts for those locations designated for new anchorage assemblies.

f. Apply prime coat in accordance with the provisions of Section 09910 entitled "Painting".

I. Pack Rust Repair

1. At locations shown on the Contract Drawings or as directed by the Engineer, repair areas of pack rust in accordance with the following procedure. Areas of pack rust repair not identified on the Contract Drawings but directed by the Engineer for cleaning will be treated as Net Cost work.

2. Prepare the surfaces and remove pack rust in accordance with the applicable requirements of Section 09913. Use the following elements of Section 09913:

a. Surface Preparation

(1) Pack Rust

(2) Remediation of Chloride

(3) Surface Preparation: Power Tool Cleaning

b. Contain and properly dispose of all material removed in the cleaning process.

c. Provide an abrasive blast to a minimum surface profile of 2 mil to the contact area.

d. Clean blasted surfaces using dry, clean compressed air per the requirements of Section 09913 or by other methods approved by the Engineer. Remove all traces of blast residue, dirt, and debris.

e. Brush apply one flood coat of epoxy penetrating sealer to all pack rust areas.

f. Apply 3¬10 mils of epoxy zinc primer to all blast-cleaned surfaces. Apply the epoxy zinc primer in a minimum of two coats and per the manufacturers' recommendations.

J. Touch-up Painting: Immediately after erection, clean bolted connections, and abraded areas of shop paint or prime coat of field applied paint. Apply paint to exposed areas using same material as used for shop painting or field applied painting in accordance with Section 09913 of the Contract specifications entitled "Paint Removal and Repainting Metal Fabrications".

K. Bolting with High Strength Bolts: Conform to AASHTO LRFD Specifications, Division II, Section 11.5.6.

END OF SECTION

SECTION 05125

ARCH RECONSTRUCTION WORK

APPENDIX "A"

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS :Geometry Control Plan
   1. Global arch survey plan
   2. Step by step erection elevation tables

B. Survey Plan for local survey of existing rivets and members

C. Transportation Plan

D. Erection Plan
   1. Sequences including equipment locations and loadings
   2. Special equipment design and plans
      a. Upper chord gantry (if used)
      b. Transfer girders
      c. Deck demolition equipment
      d. Work platforms
   3. Crane location drawings including load/radius curves for the various proposed construction activities. Include land, deck and water borne equipment for:
      a. Tower construction
      b. Edge girder erection
      c. SUP steel framing
      d. West catwalk framing

E. Existing floor system demolition plan

F. For other work related submittals, see Section 1.01.C and the requirements specified in the various referenced specification sections.

END OF APPENDIX "A"

DIVISION 5

SECTION 05156

BRIDGE SUSPENDERS (STRAND)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for fabricating, transporting and erecting bridge suspenders and suspender anchorages for the support of the suspended portion of the arch structure roadway in both the final and temporary conditions. Each bridge suspender assembly includes four suspenders comprised of structural strands and the associated appurtenances.

A. Related Work specified in other Sections of the Specifications includes the following:

1.	Structural Steel	Section 05120
2.	Arch Reconstruction Work	Section 05125
3.	Painting	Section 09910
4.	*Paint Removal and Repainting Metal Fabrications*	Section 09913

1.02 SYSTEM DESCRIPTION

A. Each bridge suspender assembly includes four suspenders comprised of structural strands and the associated sockets, threaded anchor rods, nuts, washers and appurtenances.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Iron and Steel Institute (AISI)
	Wire Rope User's Manual
AISI 1040	Carbon Steel
	American Society for Testing and Materials (ASTM International)
ASTM A148	Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A576	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A586	Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand
ASTM B169	Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications

ASTM E280	Standard Reference Radiographs for Heavy-Walled (4½ to 12-in. (114 to 305-mm)) Steel Castings
ASTM F436	Standard Specification for Hardened Steel Washers

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. The design and performance requirements for Bridge Suspenders shall conform to the applicable requirements of Section 05120, subsection 1.03 relative to:

1. Alternative Connections
2. Conflicts
3. Shop Drawings
4. Erection Drawings
5. Erection Procedure and Work Plan

B. Design Calculations

1. Cast Sockets: Design the cast sockets to the configuration given in the Contract Drawings. Design the sockets to develop the minimum required ultimate strength of the structural strand without suffering stresses beyond the yield point of the socket steel or excessive creep of the zinc filler under load.

1.05 QUALITY CONTROL

A. Quality Control requirements for Bridge Suspenders shall conform to the applicable requirements of Section 05120, subsection 1.04.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Properly coil or roll strands on reels in such a manner such that no permanent deformation of wires in the strand will occur.

1. Store strands in a well-protected location.
2. Handling, transporting and storing of strands shall be in accordance with the AISI Wire Rope User's Manual.
3. Replace any strands or sockets damaged by handling, transporting or storing at no additional cost to the Authority.

B. Delivery to Job Site: The suspender assemblies shall be inspected and approved for shipping by the Engineer. Transport the suspender assemblies to the job site in a manner such that no permanent deformation of the bridge strand wires occurs. Replace any bridge suspender assembly damaged by handling, transporting or storing, at no additional cost to the Authority.

C. Storage of New Bridge Strands: Store the new strands under a roofed structure. Make adequate provisions to prevent dragging of the strands at any time. Damage to the galvanized coating will be cause for rejection of the strand. The roofed structure shall meet the approval of the Engineer prior to the storage of strands.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Structural Strand: The structural strand shall be an arrangement of wires laid helically around a center wire to produce a symmetrical cross-section. The structural strand shall meet the requirements of ASTM A586 and shall be provided with a Class A weight zinc-coating on the inner wires and Class C weight zinc-coating on the outer wires.

1. For strands used in a temporary application, provide all wires with a Class A coating. The Class C coating for the outer wires is not required.
2. Pre-stretch structural strands under a tension not to exceed 55% of the breaking strength shown in the table below. After pre-stretching, the minimum Modulus of Elasticity, E, shall be as specified in the table below.

Nominal Strand Diameter (in)	Breaking Strength (tons)	Metallic Area (in^2)	Modulus of Elasticity, Pre-Stretched, (ksi)
1 5/8 (temp)	162	1.59	24,000
2 3/8	334	3.38	23,000

B. Cast Sockets: Design the cast sockets to the configuration given in the Contract Drawings. Design the sockets to develop the minimum required ultimate strength of the structural strand without suffering stresses beyond the yield point of the socket steel or excessive creep of the zinc filler under load.

1. Strand socket castings shall be cast steel conforming to the requirements of 715-02 of the Standard Specifications except that the material shall be ASTM A148, Grade 105-85) with Supplementary Requirement S9.
2. One socket per casting heat shall be radiographed in accordance with the requirements of ASTM E280. One specimen per heat shall be Charpy V-notch impact tested at minus 20 deg F.
3. Galvanize in accordance with ASTM A153.

C. Threaded Anchor Rods (Permanent): Conform to the requirements of ASTM A576, Grade 1045.

1. Charpy impact test properties shall be determined on each heat from a set of three Charpy V-notch specimens. Prepare test specimens as Type A and test in accordance with ASTM A370.
   a. *If Charpy V-notch test values are less than 20 Joules (15 ft-lb) at 40 deg F for* any heat, anchor rods represented by that heat shall be rejected.
2. Nuts: Conform to the requirements of ASTM A563, Grade A.
3. Washers: Conform to the requirements of ASTM F36, Type 1.
4. Galvanize anchor rods, nuts and washers in accordance with ASTM A153.
5. Furnish anchor rods, nuts and washers by the socket supplier.

D. Bronze Washers: Conform to the requirements of ASTM B169, Grade X

E. Neoprene Deflectors: Furnish to the dimensions shown on the Contract Drawings and shall be plain rubber, vertical load transmitting devices that contain only polychloroprene as the raw elastomer polymer.

1. The physical properties of the cured material shall comply with ASTM D2000 Line Call Out M2BC514A14B34.

2. The rubber pads shall be cast in a mold under pressure and heat, or may be furnished as a cut piece if they have been carefully cut from a larger piece of fully molded material.

3. Shape factors of each device. i.e., net load area divided by the area free to bulge, must exceed twelve (12).

2.02 FABRICATION

A. Fabrication – General: Comply with the applicable requirements of Section 05120, subsection 2.02.A for the requirements to start fabrication.

B. Fabrication of Structural Strands: Manufacture the strand to meet or exceed the strength requirements specified herein. Submit documentation of compliance with these requirements and the make-up of the wires in the strand to the Engineer.

1. Manufacture strand on machines of sufficient size to insure good workmanship and fabricate in the greatest length possible. Make no changes once the manufacture of the strands has been started to the grade of wire, construction or lay of strand, or other factors that would affect the uniformity of the finished product. Straightening of bent wires shall not be permitted. Any kinked or damaged strands shall be rejected.

2. Pre-stretch all strands by stressing each strand with a load equal to 55 percent of the breaking strength in straight tension. Maintain the load until the strand reaches a stable condition and shows a well-defined and uniform elastic stretch and recovery under stressing. Repeat the pre-stretching process until a stable, acceptable condition is achieved.

3. Determine the modulus of elasticity of each pre-stretched length of strand in accordance with ASTM A586.

4. Measure the strand in the shop for the various suspender lengths while under tension equal to the full dead load. Then cut for use in the suspenders. When cutting the strand, allow for obtaining test specimens for strand and socket testing as specified herein.

5. At the time the strands are measured, make a continuous paint stripe on one side of the strand for its entire length to assure correct alignment of the strands during erection.

6. Provide strand identification marks in order to facilitate erection. Provide each strand with a legible waterproof tag firmly attached to it giving:

   a. The fabricated length

   b. The location where it is to be installed on the bridge

7. The length of suspender strands is provided in the Contract Drawings. Field verification by the Contractor is required.

C. Socket Installation: Attach the sockets to the strands in accordance with the approved procedures submitted prior to socketing.

1. Attach sockets to the structural strand at 20% of the minimum breaking strength of each diameter strand.

2. Clean wires of the strands of grease and other impurities by a carefully controlled process that will assure no harm is done to the wire galvanized coating of the wires after being splayed in preparation for socketing. Re-lubricate the strand wires adjacent to the socket after socketing.

3. Preheat the basket of the socket to expel moisture and to prevent the molten zinc from congealing before it has completely filled the narrow lower end of the basket. Strands shall be rejected if the socketing procedure results in bare wires within the socket.

4. The zinc used to attach the sockets to the strand shall comply with ASTM B6, High Grade, or better. The molten zinc shall be placed at the lowest practical temperature, usually within the range of 925 deg F to 975 deg F; never over 1000 deg, so as to minimize the affect of heat on the strands. Record the zinc temperature at time of pouring for each socket. Perform the filling of the socket with molten zinc in one continuous operation.

5. Take care to insure socket and strand alignment and that the lengths of the suspender after socketing are correct. Submit a tabulation of shop-measured lengths of each suspender for use in erecting the suspenders.

2.03 SHOP FINISHING

A. Socket Finishing: Neatly finish sockets to the exact dimensions shown on the approved shop drawings. Visually examine each socket for defects. Repair defects judged to be unacceptable by the Engineer to the satisfaction of the Engineer, or replace the socket with a new casting. The Engineer shall be the sole judge as to the reparability of a socket. To determine the type and amount of repair, where repairs are required, perform such additional non-destructive tests at each unacceptable defect as the Engineer may consider necessary. Such tests may be radiograph, ultrasonic, magnetic particle, or liquid penetrant as the Engineer may direct or approve. Such testing shall be at no additional cost to the Authority. Examine weld preparation by magnetic particle or liquid penetrant methods in accordance with ASTM A781, S5. Retest repaired areas using magnetic particle or liquid penetrant methods as directed or approved. At the Engineer's option, large repairs may require hear treatment in accordance with the requirements of ASTM A148. The Engineer shall be the sole judge as to the suitability of a repaired socket.

1. Supply each strand socket drawing along with calculations for each socket. Supply only cast strand sockets designed for strand.

2. After fabrication, demonstrate that the nuts, when turned by hand, move freely on the threads of the anchor rods.

2.04 SHOP TESTING

A. Testing of Strand Wires: Test, prior to fabrication, the zinc-coated steel wire used in the manufacture of the structural strand for physical properties in accordance with Paragraph 5 of ASTM A586 and the following:

1. Perform the test for tensile strength on samples of not less than 10 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the Engineer may require that all coils of such lot be tested. All individual coils which do not meet the requirements for tensile strength will be rejected.

2. Perform the test for strength at 0.7 percent extension samples of not less than 10 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the Engineer may require that all coils of such lot be tested. All individual coils which do not meet the requirements for tensile strength will be rejected.

3. Perform tests for zinc coating (weight and adherence) on samples of not less than 5 percent of the coils of any lot of zinc-coated wire. If tests of any of these coils fail to meet the requirements, the Engineer may require that all coils of such lot be tested. Unless at least 80 percent of the coils pass the test, the entire lot shall be rejected. Any coil failing to meet the requirements shall be rejected.

B. Testing of Structural Strands: From each pre-stretched length of strand, one piece not less than 100" long shall be cut and tested to demonstrate the strength of the strand and sockets as specified in Paragraph 9 of ASTM A586.

1. Socket the ends of the test pieces with sockets selected at random from loose stock that are to be used in filling the order. Use the same material and method of socketing for both the test pieces and the production strand.
2. Attach sockets to the jaws of the testing machine in such a manner that stresses in the socket will reproduce those expected when the socket is installed in the bridge.
3. Provide positive means to assure that the strand does not twist after pre-stretching and that the upper and lower sockets are kept free from rotating with respect to each other.
4. Stress the first six test pieces, and any others directed by the Engineer, to destruction in a suitable testing machine. Test all pieces to not less than the minimum specified breaking strength. Provide sockets which in every instance are of sufficient strength to produce failure in the strand material.
5. If, after six or more tests of pre-stretched strands have been made, the Engineer finds that the strength and elasticity have sufficient uniformity, the Engineer may direct that the testing be reduced to two pieces, one from each end of each manufactured length of strand instead of one from each pre-stretched length.
6. The sockets used for these tests shall not be used in the bridge.
7. If a socket should break during the strand testing specified above, select two additional sockets, attach to strand, repeat the test.
   a. Continue this testing until the Engineer is satisfied of the socket reliability, at which point the lot shall be accepted. If 10 percent or more of all the sockets tested break at a load less than the specified minimum breaking strength, the entire lot shall be rejected; furnish new ones, of greater resistance.

PART 3. EXECUTION

3.01 ERECTION

A. Suspender Erection: Erect suspenders with sockets in the same relative position to each other as existed when suspender strands were measured and with the paint stripe in a straight line. Equally stress each suspender strand in the four-strand suspender. Exercise extreme care to prevent twisting of the suspender strands during erection. Perform field adjustments to suspender tension and roadway profile grade in accordance with the following:

1. Make field adjustments to suspender tension and roadway profile grade at the lower connection (at the floor beams) shall be made under floor system framing dead load and again under full dead load.
2. Tension each suspender strand in a four-strand suspender using calibrated jacks in accordance with the approved jacking procedure.
3. Submit a written suspender installation procedure as part of the Erection Plan specified in Section 05125 Arch Reconstruction Work.

END OF SECTION

SECTION 05156

BRIDGE SUSPENDERS (STRAND)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05156A01 Submit detailed Shop Drawings delineating the fabrication of the bridge suspender system including sockets and zinc process for securing the strand in the socket.
Submit to the Engineer for approval in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

Catalog Cuts

05156B01 Socket assemblies for permanent and temporary suspenders.

05156B02 High Strength Anchor Rods & Appurtenances conforming to ASTM A722

05156B03 Stressing equipment for high strength anchor rods

Certificates

05156E02 Documentation that welding inspection personnel are qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors

Manufacturer Test Reports

05156F01 Certified mill test reports for steel and zinc used to manufacture socketed bridge strand suspenders.

05156F02 Certified mill test reports for bronze used to manufacture bronze washers for the suspender anchorages.

05156F03 Certified mill test reports for high strength anchor rods conforming to ASTM A722, Type 2.

05156F04 Certified mill test reports for high strength anchor rods conforming to ANSI 1040, Grade

60.

05156F05 Tensile Tests for Strand Wire, 2.04A

05156F06 Tensile Tests for Assembled Suspender, 2.04B

Calculations

05156H01 Design the cast sockets to the configuration given in the Contract Drawings. Design the sockets to develop the minimum required ultimate strength of the structural strand without suffering stresses beyond the yield point of the socket steel or excessive creep of the zinc filler under load. Submit for permanent and temporary suspenders.

Information

05156S01 Store the new strands under a roofed structure. The roofed structure shall meet the approval of the Engineer prior to the storage of strands.

05156S02 Should repair work on the sockets require welding, submit welder qualifications and welding procedure specifications in accordance with Section 05120, paragraph 1.04 B prior to commencing repair operations. Include documentation that welding inspection personnel are qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors

05156S03 1) Suspender identification
2) Measured length face to face of sockets
3) Modulus of Elasticity as determined by ASTM A586

END OF APPENDIX "A"

DIVISION 5

SECTION 05168

OVERHEAD SIGN STRUCTURE

PART 1. GENERAL

1.01 SUMMARY

A. Under this work the Contractor shall fabricate, furnish and erect sign structures for overhead signs in accordance with the contract documents.

This work includes upright supports, span arms and truss assemblies, anchor bolts, templates used to ensure the proper alignment of the anchor bolt system, diagonal bracing, all necessary hardware, nuts, bolts, and washers, and foundations.

This work also includes all luminaire supports, support beams, saddle and saddle assemblies, splices, stubs, shims, washers, stub assemblies, post wire inlets, variable thickness shim plates, weepholes, cambering, welds, bird screens, continuous backing ring, cap details, post handholes (stainless steel washers, nuts and fasteners), Z bars, Type B pads between connection angle and vertical Z bars and U bolts and all other material, equipment, labor, and incidentals necessary to properly complete the work as shown in the Contract Drawings and called for in the specifications.

B. The Contractor shall notify the Engineer of the name and address of the fabricator of all overhead sign structures in accordance with NYSDOT Specification Section 106-01 Sources of Supply.

1.02 REFERENCES

A. New York State Department of Transportation Standard Specifications, Construction and Materials (US Customary), dated May 1, 2008 with current additions and modifications.

NOTE: In the various subsections of the NYSDOT Steel Construction Manual (SCM) or the NYSDOT Standard Specifications referenced in this specification, references to "The Department", "The State" or "NYSDOT" shall be taken to mean The Port Authority of New York and New Jersey (Authority).

References to "The Regional Construction Engineer", or "Deputy Chief Engineer (D.C.E.)", "Deputy Chief Engineer Structures (D.C.E.S.)" or "Material Bureau" shall be taken to mean The Port Authority of New York and New Jersey Engineer (Engineer).

B. New York State Department of Transportation Steel Construction Manual (SCM), 3rd Edition, dated March 2008, with current additions and modifications for fabrication and erection.

C. American Welding Society (AWS) – applicable AWS codes for all welding and welding inspection.

1.03 RELATED SECTIONS

A. Section 02221 Excavation Backfilling and Filling

B. Section 02378 Drilled Shafts

C. Section 03200 Concrete Reinforcement

D. Section 03301 Cast-in-Place Concrete

E. Section 05120 Structural Steel

1.04 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. The materials requirements of NYSDOT Specifications Section 644-2.01, Overhead Sign Structures, shall apply.

Steel for sign structures and steel for component parts of sign structures shall meet the requirements of the New York State Steel Construction Manual and the following:

All material greater than 1/2 inch thick shall meet the Charpy V-Notch toughness requirements of NYSDOT Standard Specifications Section 715-01, Structural Steel. Chords, end posts, base plates, and flange splice plates shall be considered main members. Diagonals, struts and gusset or tab plates shall be considered secondary members.

Upon receipt at the fabrication plant, all main member material shall be traceable to a mill test report and traceability shall be maintained throughout the duration of the fabrication.

All main member material thickness shall be a minimum of ¼ inch.

Shim plates shall be galvanized.

B. Z – Bars shall be non-welded aluminum alloy 6061-T6.

C. All stainless steel bolting material shall be ASTM A193, Grade B8.

D. Galvanizing requirements of NYSDOT Specification Section 644-2.01F shall apply.

E. The requirements of Specification Section 03301 shall apply for structural concrete.

F. Backfill – See Section 02221 Excavation, Backfill and Filling, for backfill material requirements.

PART 3. EXECUTION

3.01 DRAWINGS

A. *Shop drawings shall be required for all Overhead Sign Structures (OSS), including the* foundations, as shown in the Contract Drawings. The Contractor shall submit shop drawings in accordance with the requirements of Specification Division 1, General Provisions.

3.02 FABRICATION

A. All fabrication, inspection, transportation and erection shall be performed in accordance with the requirements of the New York State Steel Construction Manual.

B. The following requirements shall apply:

1. Storage of Materials. Structural material shall be stored in a manner that will protect the materials from deformation, surface deterioration and accumulation of dirt, oil, or other foreign matter.

2. Straightening Materials. Prior to erection in the field all deformed structural materials shall be properly straightened by methods which are non-injurious. Sharp kinks and bends, and deep dents shall be cause for rejection.

3. High Strength Bolts. Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.5b of the New York State Steel Construction Manual. Fasteners shall be inspected after installation in accordance with Section 1001.6 of the New York State Steel Construction Manual. The inspection shall apply to a minimum of 10% of the connections randomly throughout the entire span of the structure. Details of the inspection shall be recorded by the Contractor and submitted to the Engineer. All holes for high strength bolts in main members shall be made in accordance with Section 613 of the New York State Steel Construction Manual. This requirement also includes all secondary members that are welded to main members.

4. Quality. Fabricators shall be certified in accordance with the American Institute of Steel Construction's Quality Certification Program in the Simple Steel Bridge Structures Category, or an equivalent program acceptable to the Engineer. Evidence of certification shall be submitted to the Engineer.

5. Inspection. Provisions for shop inspection shall be in accordance with the New York State Steel Construction Manual.

6. Acceptance for Shipping. Each section of a sign structure shall bear the Quality Assurance inspector's mark of acceptance prior to shipping.

7. The Contractor shall submit evidence in writing that the installer/erector is approved by the overhead sign structure manufacturer or is being erected under the approved technical advisor of the overhead sign manufacturer.

3.03 TRANSPORTATION

A. Sign structures (including posts and post assemblies) shall be shipped by flat bed trailer or other similar means. Structures shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage from occurring during transportation. The use of any device which does not support the member for its entire length shall not be permitted. This prohibition includes, but is not limited to, dolly wheels and pole trailers.

B. Adhering to these requirements does not relieve the Contractor of the responsibility for damage to the structure en route.

3.04 ERECTION OF OVERHEAD SIGN STRUCTURE

A. A. Methods and Equipment. Before starting work, the Contractor shall submit details of the method of erection, procedures and types of equipment he proposes to use, to the Engineer for review and approval. Approval shall not relieve the Contractor of the responsibility for the safety of the methods or equipment, or for damage to the structures due to overloading.

B. Handling and Storage. Structural members shall be loaded, moved, and unloaded in a manner that prevents stresses in excess of those provided for by the structure design. Permanent distortion, or other damage attributable to the Contractor's operations, shall be cause for rejection. Members stored either in the fabricator's storage area, or at the work site, or at other storage areas, shall be supported off the ground in a manner that will not allow distortion, or other damage to occur.

C. Lifting. Erection of overhead sign structures shall be done in accordance with NYSDOT Specification Section 107-05P., Lifting. Lift Plans are required, and shall be submitted for approval in accordance with NYSDOT Specification section 107-05P.3. Nylon slings, or an equivalent approved by the Engineer, shall be used for all lift operations. Picking points for the superstructure portion of span type OSS shall be made at the panel points that are closest to the third points of the span, in order to ensure that no members are overstressed during lift operations. Picking shall be made by wrapping the entire cross section of the structure.

When alternate pick points are used, the Contractor shall submit calculations which show that the proposed operation is safe and/or that the operation will not cause an overstress condition. The calculations and any supporting drawings or other information shall be stamped and signed by a currently registered New York State licensed Professional Engineer. However, lifting by chains or by individual members shall not be permitted.

The Contractor shall obtain permit from the Authority for any operation during the erection of the overhead sign structures that requires road or lane closure.

D. Field Inspection. All sign structures shall be visibly inspected, and components shall be clean prior to erection. Damage that is attributable to the Contractor's operations shall be cause for rejection. Damage includes, but is not limited to, bends, kinks, dents, cracks and pits. Rejected structures, or components, shall be removed from the work site and repaired, or replaced as required by the Engineer. All work relating to the repair or replacement, of defective structures, or components, shall be done at no additional cost to the Authority.

E. Anchor Bolts. The Contractor shall submit his anchor bolt tightening sequence and leveling procedures to the Engineer for review and approval. The following procedure shall be used for placing and tightening anchor bolts. :

1. Anchor bolts shall be carefully set to the proper location, alignment, and elevation by using templates. Templates shall be as detailed in the Contract Drawings, and shall be used at both the top and bottom of the anchor bolt pattern. Bottom templates shall be cast into the footing. Top templates shall be placed near the top of the anchor bolts so as not to interfere with concrete operations, and shall be left in place for 24 hours after concrete placement. Undamaged top templates may be reused.

2. Anchor bolts shall be set vertical, within 2.5% of plumb, and shall not be realigned by bending to fit the base plate. Anchor bolts that do not fit the base plate, or anchor bolts that are more than 2.5% out of plumb, shall be rejected. The Contractor may propose a remediation method for the rejected anchor bolts, subject to the approval of the Engineer. Rejected anchor bolts, and the concrete they are embedded in shall be replaced by new materials at no cost to the Authority.

3. The exposed portion of the anchor bolts shall be cleaned with a wire brush. The *leveling nuts and washers under the base plate shall be threaded onto the anchor* bolts, leaving a gap between the top of concrete and the bottom of the leveling nuts of no more than one anchor bolt diameter, and no less than 3/8 inch.

4. The post(s) alone, without the arms attached, shall be placed on the leveled anchor bolts and washers. Posts shall not be raked to account for camber. The base plate shall bear directly and evenly on the washers and leveling nuts.

5. Beeswax, or the equivalent, shall be applied to the bearing face and the threads inside the top nut. The top anchor bolt nuts and washers shall then be placed and tightened by hand. All cleaning and lubricating shall be done immediately prior to nut placement and tightening. Top nuts and leveling nuts shall be checked for full bearing against the base plate, and any loose nuts shall be tightened by hand. The top nuts shall then be snug tightened using 20 - 30% of the torque values listed in Table 1 below. The snugging sequence shall be as shown in Figure 1 below. The leveling nuts shall then be similarly checked for snug tightness, using 20 - 30% of the values listed in Table 1.

6. Fully tighten all top nuts according to the torques listed in Table1 below. The tightening sequence shall be as shown on the Contract Drawings. There shall be no rotation of the leveling nut during this procedure.

7. An additional nut shall be installed and tightened against the top nut to lock the installation. This lock nut shall be prepared and tightened as defined in No. 5 and No.6 above. There shall be no rotation of the lower top nut during this procedure.

TABLE 1- ANCHOR BOLT TORQUE

Anchor Bolt Size (inches)	Required Torque (±5%) (ft•lbs)
1 ½	650
1 ¾	1,000
2	1,500
2 ¼	2,200
2 ½	3,000

F. *Bolting. Bolted steel connections shall be made with bolts, nuts and washers meeting the* material requirements of NYSDOT Specification Section 715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of NYSDOT Specification Section 719-01, Galvanized Coatings and Repair Methods. Each bolt shall be furnished with a galvanized flat washer installed under the turned element.

All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. Any gaps between the faying surfaces after snug tightening that exceed 1/16 inch shall not be considered in full contact and shall be cause for rejection. Rejected components shall be replaced or repaired at no cost to the Authority.

Bolts shall not be fully tightened before said tolerances are checked. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.5b of the New York State Steel Construction Manual. Fasteners shall be inspected after installation in accordance with Section 1001.6 of the New York State Steel Construction Manual.

G. Welding. Field welding shall not be permitted on any part of the structure, except as noted on the Contract Drawings and approved by the Engineer.

H. Galvanized Metal Repair. The Contractor shall repair any damage to galvanized surfaces in conformance with the field repair requirements specified in NYSDOT Specification Section 719-01, Galvanized Coatings and Repair Methods, except that zinc paint applied by the spray method shall not be permitted. No payment shall be made for repairs to galvanizing that has been damaged.

END OF SECTION

SECTION 05168

OVERHEAD SIGN STRUCTURE

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05168A01 Complete overhead sign structure fabrication shop drawings, including superstructure layout.

05168A02 Complete overhead sign structure foundation shop drawings, including foundation layout, coordinated with the sign structure drawings.

05168A03 Overhead sign structure erection drawings and lift plan - signed and sealed by a Professional Engineer licensed in the State of New York. Includes details of the methods and procedures of erection, lifting and sequence, and types of equipment to be used: slings, supports, etc..

Catalog Cuts

05168B01 Catalog cuts for all products and components to be used in the overhead sign structure system including: Product name, manufacturer, details, manufacturer's specifications and certified test data/analysis of each product.

Product Data

05168D01 Product data showing compliance with the specified galvanizing of components requirement.

05168D02 A complete "Products List", listing all products to be used including: product name, manufacturer, catalog cuts, details, samples (if requested by the Engineer), manufacturer's specifications and certified test data/analysis of each product.

Certificates

05168E01 The overhead sign structure fabricator shall submit evidence of shop welder"s certification in accordance with NYSDOT requirements.

Manufacturer Test Reports

05168F01 Testing reports (mill certificates) of the materials used in the overhead sign structure including foundation anchor bolts.

Construction and Installation Procedures

05168G01 The Contractor shall submit as part of his installation plan the sequence to "snug" tight through final tightening the nuts on the anchor bolts as part of the overhead sign structure installation and leveling sequence.

Calculations

05168H01 Overhead sign structure erection and lift plan calculations - signed and sealed by a Professional Engineer licensed in the State of New York. Includes details of the methods of erection, lifting and sequence, and types of equipment to be used: slings, supports, etc..

Qualifications

05168K01 The Contractor must certify in writing that the installer/erector of the overhead sign structure is approved by the overhead sign structure manufacturer, or is being erected under the direction of an approved technical advisor of the overhead sign structure manufacturer.

05168K02 Qualifications that the manufacturer/fabricator is certified in accordance with AISC Constructions Quality Certification program in the simple steel bridge structures category or equivalent program acceptable to the engineer.

Inspection Reports

05168O01 Field inspection of the overhead sign structure erection and fastener installation in accordance with NYSSCM and inspection of minimum 10% connections, and documented by the Contractor that the finished product has been erected in accordance with the approved drawings and the contract documents.

Contact Information

05168P01 Contact information of the overhead sign structure manufacturer/fabricator in accordance with NYSDOT Specification Section 106-01.

Permits

05168T01 Contractor shall obtain permit from the Authority for any operation during erection and lifting that requires roadway or lane closure of the Bayonne Bridge

END OF APPENDIX "A"

DIVISION 5

SECTION 05170

TOLL GANTRY

PART 1. GENERAL

1.01 SUMMARY

A. Under this work the Contractor shall design, fabricate, furnish and erect, and perform final in-depth inspection of a pre-engineered/prefabricated space frame canopy structure, including bearing devices, assemblies, all necessary hardware, nuts, bolts and washers for a complete installation in accordance with the Contract Documents, and as directed by the Engineer. The Contractor shall have the option to fabricate the space frame canopy structure from galvanized steel.

B. This work shall also consist of fabricating, furnishing and erecting a steel support post system to support the space frame canopy structure in accordance with the contract documents and as directed by the Engineer. The steel support post system shall be fabricated from galvanized steel.

C. The steel space frame shall include all brackets and accessories required for conduit mounting and wiring as indicated on the Contract Plans.

D. This work also includes foundations, anchor bolts and templates used to ensure proper alignment of the anchor bolt system for a complete installation.

E. The Contractor is hereby advised a pre-engineered/pre-fabricated steel space frame offered as stock items by various firms may require re-design or modification to meet specification and details as shown in the plans.

F. The complete system, including space frame, bearing devices and related accessories shall be designed, engineered and fabricated by a single entity. In no instance will a space frame system be approved that has been either engineered and/or fabricated by separate entities.

G. The Contractor shall notify the Engineer of the name and address of the fabricator of the space frame canopy structure in accordance with NYSDOT Specification Section 106-01 Sources of Supply.

1.02 REFERENCES

A. Design of the space frame canopy and steel post support system shall be in accordance with the contract documents and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, 5th Edition, with Interims through 2012.

B. New York State Department of Transportation Standard Specifications, Construction and Materials (US Customary), dated May 1, 2008 with current additions and modifications.

C. NOTE: In the Various subsections of the NYSDOT Steel Construction Manual (SCM) or the NYSDOT Standard Specifications referenced in this specification, references to "The Department", "The State" or "NYSDOT" shall be taken to mean The Port Authority of New York and New Jersey (Authority).

D. References to "The Regional Construction Engineer", or "Deputy Chief Engineer (D.C.E.)", "Deputy Chief Engineer Structures (D.C.E.S.)" or "Material Bureau" shall be taken to mean The Port Authority of New York and New Jersey Engineer (Authority).

E. New York State Department of Transportation Steel Construction Manual (SCM), 3rd Edition, dated March 2008 with current additions and modifications for fabrication and erection.

F. *2010 AASHTO LRFD Bridge Construction Specifications, 3rd Edition*

G. ASCE 7-05 Minimum Design Loads for Buildings and other Structures

H. American Welding Society (AWS) – applicable AWS codes for all welding and welding inspection.

1.03 RELATED SECTIONS

A.	Section 02221	Excavation Backfilling and Filling
B.	Section 02378	Drilled Shafts
C.	Section 03200	Concrete Reinforcement
D.	Section 03301	Cast-in-Place Concrete
E.	Section 05120	Structural Steel

1.04 QUALITY ASSURANCE

A. The entire pre-fabricated steel space frame, including the bearing systems, shall be designed, and detailed on a set of record plans approved by a New York State Licensed Professional Engineer, hereinafter, referred to as the Firm's Engineer. All drawings shall be signed and sealed by the Firm's Engineer prior to submittal.

B. The design and detailing of welded connections shall be in accordance with: For non-tubular components: AASHTO/AWS D1.5-95 Bridge Welding Code; For tubular components: AWS D1.1-96, Structural Welding Code Cyclically Loaded Structure provisions; and any additions and/or modifications noted herein. All drawings shall bear Engineer approval prior to submittal.

C. Manufacturer's Qualifications:

1. The manufacturer shall have not less than five (5) years experience in manufacturing steel space frame canopy structures consisting of round tube top and bottom chords and round tube webs and solid spherical node design for projects of equivalent size and complexity as required by these contract documents.

2. The steel space frame shall be designed, engineered and fabricated by a single entity. In no instance will a space frame system be approved that has been either engineered and/ or fabricated by separate entities.

3. The manufacturer must certify in writing that materials have been tested in accordance with a certified quality assurance program and that the manufacturer has supervised all elements of fabrication necessary for the manufacture of the space frame and that all materials have proven to be satisfactory for the use intended by these contract documents.

4. The erection of the space frame shall be done by an installer certified/approved by the space frame manufacturer or under the direction of a technical advisor of the space frame manufacturer.

1.05 DESIGN AND PERFOMANCE REQUIREMENTS

A. Design Criteria: The design of the structure shall be in accordance with the References listed in Subsection 2.0, and in accordance with the Contract Documents. The following shall be required as minimum:

1. Wind Load: The structure shall be designed for a minimum wind load of 40 pounds per square foot. The structure shall also be designed for wind uplift.

2. Seismic: The structure shall be designed for the seismic intensity for the appropriate zone.

3. Equipment Dead Load: The structure shall be designed for a total Equipment Dead Load of 2 pounds per square foot.

4. Ice Load: Structure designed for an Ice Load of 3 pounds per square foot on full circumference of all members.

5. Temperature: The structure shall be designed to accommodate a temperature variation of 120°F.

6. Application for design loads: All design loads shall be applied to the steel space frame nodal points. No loads shall be applied to any chords or webs except those expressly noted in the contract document.

7. Friction Fit: No components shall be secured by friction fit.

8. Geometry: A space frame consists of two plane grids, parallel to each other which form the upper and lower layers of the space frame. These two grids are connected to each other with the use of diagonal bars. The external loads are distributed among the two parallel layers and the diagonal bars which connect them. Span length, minimum underclearance and clear width between steel columns supporting the space frame shall be as indicated on the Contract Plans.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Firms offering pre-engineered/pre-fabricated steel space frames which meet the general requirements indicated in the Contract Plans include, but are not limited to the following:

1. Delta Structures, Inc. 811 Eagle Drive, Bensenville, IL 60106

2. Novum Structures, LLC, W126 N8585 Westbrook Crossing, Menomonee Falls, WI 53051

3. Gossamer Space Frames, 5622 Research Drive, Ste. B, Huntington Beach, CA 92649

2.02 MATERIALS

A. The materials requirements of NYSDOT Specifications Section 644-2.01 shall apply.

B. Steel for the space frame canopy structure and support post system and steel for component parts of the structure systems shall meet the requirements of the New York State Steel Construction Manual and the following:

C. All material greater than 1/2 inch thick shall meet the Charpy V-Notch toughness requirements of NYSDOT Standard Specifications Section 715-01, Structural Steel. Chords, end posts, base plates, and flange splice plates shall be considered main members. Diagonals, struts and gusset or tab plates shall be considered secondary members. Upon receipt at the fabrication plant, all main member material shall be traceable to a mill test report and traceability shall be maintained throughout the duration of the fabrication.

D. All main member material thickness shall be a minimum of ¼ inch.

E. Steel Tubes: All tube members shall be round structural steel tubing (ASTM A500 Grade B or equivalent minimum) with centrally welded (E-70X) truncated forged steel comes (ASTM A669 Class A) at each end welded per AWS joint designation B-U4a-GS. No access or finish holes shall be permitted in structural members. Tubes shall be sized by design load structural analysis. Access and vent holes will exist if the product is to be hot dip galvanized, after welding.

F. Steel Nodes: All steel nodes shall be hot pressed spherical forgings (ASTM A563 Grade B) of solid material with the connection holes bored and tapped for the required bolts. Compression surfaces shall be milled flat. There shall be no superfluous holes. Nodes shall be sized per design load structural analysis and tube connection interference criteria.

G. Bolts: All bolts shall be of Standard Dimensions as designated by the design loads given in the structural analysis. Bolts shall meet the requirements of ASTM A325.

H. Sleeves: All spanner sleeves shall be machined from solid steel and shall meet the requirements of ASTM A563 Grade B.

I. Purlin Stools: All purlin stools shall be fabricated from hot rolled steel and shall meet the requirements of ASTM A36. The threaded rod shall meet the requirements of A325.

J. Seat Fittings: All seat fittings shall be fabricated from ASTM A36 steel.

K. Finish: All space frame tubes shall be hot dip galvanized on both exterior and interior surfaces to a minimum zinc film thickness of 55 microns as per ASTM A123. Tubes shall be completely free of drip lines and blemishes from galvanizing process. All threaded or tapped parts shall be electro-galvanized according to ASTM B633.

L. Welding Procedures: All welding procedures must be qualified in accordance with AWS D1.5 Section 5 Qualification. In general, the provisions of Article 5.12 shall apply. Qualification tests shall measure tensile strength, yield strength, toughness and ductility, with results evaluated in accordance with Article 5.19. All Welding Procedure Qualification and Welding Procedure Specifications must be submitted to the New York State Thruway Authority's Metal Engineering Unit for approval.

M. All welders shall be certified in accordance with Section 8 Part B of the New York State Steel Construction Manual, including current Addenda.

N. Samples: The Fabricator shall submit:

1. One (1) sample full size "node" with connecting member having the specified finish.

2. Product Data showing compliance with galvanizing of components and other quality and fabrication requirements.

O. All stainless steel bolting material shall be ASTM A193, Grade B8.

P. Galvanizing requirements of NYSDOT Specification Section 644-2.01F shall apply.

Q. Foundations: The requirements of Section 03301 shall apply for structural concrete.

PART 3. EXECUTION

3.01 DRAWINGS

A. The Firm's Engineer shall prepare a complete set of record plans including superstructure layout and all components to be incorporated into the space frame canopy structure, hereinafter referred to as Working Drawings. These drawings shall be prepared consistent with fabrication shop drawings. All work, including component fabrication shall be performed in accordance with the approved Working Drawings.

B. Calculations and specifications also shall be required for the space frame canopy and steel post support system in the contract documents. The Contractor must submit working drawings, calculations and specifications in accordance with the requirements of Specification Division 1 – General Provisions. All requirements of Section 2 in the New York State Steel Construction Manual shall apply where applicable.

C. Working Drawings shall be prepared on standard 22" x 34" nominal size sheets with a working area of 21" x 33 ½"

3.02 FABRICATION

A. All fabrication, inspection, transportation and erection shall be performed in accordance with the requirements of the New York State Steel Construction Manual and the space frame canopy and steel post support system Manufacturer. When a conflict exists between the requirements of the Manufacturer and the Contract Specifications and the requirements of additional specifications, such as the NYSDOT Specifications, the Contractor shall be required to comply with the more stringent requirement or combination of requirements.

B. The following requirements shall apply:

1. Storage of Materials. Structural material shall be stored in a manner that will protect the materials from deformation, surface deterioration and accumulations of dirt, oil, or other foreign matter.

2. Straightening Materials. Prior to erection in the field all deformed structural materials shall be properly straightened by methods which are non-injurious. Sharp kinks and bends, and deep dents shall be cause for rejection.

3. High Strength Bolts. Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.5b of the New York State Steel Construction Manual. Fasteners shall be inspected after installation in accordance with Section 1001.6 of the New York State Steel Construction Manual. The inspection shall apply to a minimum of 10% of the connections randomly throughout the entire span of the structure. All holes for high strength bolts in main members shall be made in accordance with Section 613 of the New York State Steel Construction Manual. This requirement also includes all secondary members that are welded to main members.

4. Quality. Fabricators shall be certified in accordance with the American Institute of Steel Construction's Quality Certification Program in the Simple Steel Bridge Structures Category, or an equivalent program acceptable to the Engineer.

5. Inspection. Provisions for shop inspection shall be in accordance with the New York State Steel Construction Manual.

6. Assembly. All the space frame canopy and steel post support system shall be fully assembled in the fabrication shop to ensure proper fit-up.

7. Acceptance for Shipping. Each section of a sign structure shall bear the QA inspector's mark of acceptance prior to shipping.

3.03 TRANSPORTATION

A. The space frame canopy and steel post support system structures (including posts and post assemblies) shall be shipped by flat bed trailer or other similar means. Structures shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage from occurring during transportation. The use of any device which does not support the member for its entire length, as described below, shall not be permitted. This prohibition includes, but is not limited to, dolly wheels and pole trailers.

B. Sections less than 50 feet in length shall be, at a minimum, supported at the midspan and end points. Sections 50 feet and longer shall be, at a minimum, supported at the ends and at the quarter points.

C. Adhering to these requirements does not relieve the Contractor of the responsibility for damage to the structure en route.

3.04 ERECTION OF THE SPACE FRAME CANOPY AND STEEL POST SUPPORT SYSTEM

A. Methods and Equipment. Before starting work, the Contractor shall submit details of the method of erection and types of equipment he proposes to use, to the Engineer for review and approval. Approval shall not relieve the Contractor of the responsibility for the safety of the methods or equipment, or for damage to the structures due to overloading.

B. Handling and Storage. Structural members shall be loaded, moved, and unloaded in a manner that prevents stresses in excess of those provided for by the structure design. Permanent distortion, or other damage attributable to the Contractor's operations, shall be cause for rejection. Members stored either in the fabricator's storage area, or at the work site, or at other storage areas, shall be supported off the ground in a manner that will not allow distortion, or other damage to occur.

C. Lifting. Erection of the space frame canopy and steel post support system shall be done in accordance with NYSDOT Specification Section 107-05P., Lifting. Lift Plans are required, and shall be submitted for approval in accordance with NYSDOT Specification section 107-05P.3. Nylon slings, or an equivalent approved by the Engineer, shall be used for all lift operations. The Contractor shall submit calculations which show that the proposed operation is safe and/or that the operation will not cause an overstress condition. The calculations and any supporting drawings or other information shall be stamped and signed by a currently registered New York State licensed Professional Engineer. However, lifting by chains or by individual members shall not be permitted.

D. The Contractor must obtain permit from the Authority for any operation during the erection of the overhead sign structures that requires any roadway or lane closure of the Bayonne Bridge.

E. Protection. During the erection and until inspection, the space frame shall be protected from damage. All bent or distorted members shall be replaced with new, undamaged members. Upon completion and inspection, it shall be the responsibility of the Contractor to protect the space frame damage during the remainder of the construction of the project and until Authority acceptance. Damage shall be cause for rejection. Damage includes, but is not limited to, bends, kinks, dents, cracks and pits. Rejected structures, or components, shall be removed from the work site and repaired, or replaced as required by the Engineer. All work relating to the repair or replacement, of defective structures, or components, shall be done at no additional cost to the Authority.

F. Field Inspection. The completed steel space frame canopy and steel post support system structure shall undergo a full and complete final inspection visibly by a duly trained representative of the manufacturer and shall be certified by the manufacturer that the finished product has been manufactured and erected in accordance with the manufacturer's approved erection drawings and the contract documents. All components shall be clean prior to inspection.

G. Anchor Bolts. The following procedure shall be used for placing and tightening anchor bolts:

1. Anchor bolts shall be carefully set to the proper location, alignment, and elevation by using templates. Templates shall be as detailed in the contract documents, and shall be used at both the top and bottom of the anchor bolt pattern. Bottom templates shall be cast into the footing. Top templates shall be placed near the top of the anchor bolts so as not to interfere with concrete operations, and shall be left in place for 24 hours after concrete placement. Undamaged top templates may be reused.

2. Anchor bolts shall be set vertical, within 2.5% plumb, and shall not be realigned by bending to fit the base plate. Anchor bolts that do not fit the base plate, or anchor bolts that are more than 2.5% out of plumb, shall be rejected. The Contractor may propose a remediation method for the rejected anchor bolts, subject to the approval of the Engineer. Rejected anchor bolts, and the concrete they are embedded in shall be replaced by new materials at no cost to the Authority.

3. The exposed portion of the anchor bolts shall be cleaned with a wire brush. The leveling nuts and washers under the base plate shall be threaded onto the anchor bolts, leaving a gap between the top of concrete and the bottom of the leveling nuts of no more than one anchor bolt diameter, and no less than 3/8 inch.

4. The post(s) alone (without any space framing attachments), shall be placed on the *leveled anchor bolts and washers. Posts shall not be raked back to account for* camber. The base plate shall bear directly and evenly on the washers and leveling nuts.

5. Beeswax, or the equivalent, shall be applied to the bearing face and the threads inside the top nut. The top anchor bolt nuts and washers shall then be placed and tightened by hand. All cleaning and lubricating shall be done immediately prior to nut placement and tightening. Top nuts and leveling nuts shall be checked for full bearing against the base plate, and any loose nuts shall be tightened by hand. The top nuts shall then be snug tightened using 20 - 30% of the torque values listed in Table 1 below. The "snugging" sequence shall be submitted as part of the Contractor's installation plan. The leveling nuts shall then be similarly checked for snug tightness, using 20 - 30% of the values listed in Table 1.

6. Fully tighten all top nuts according to the torques listed in Table1 below. The tightening sequence shall be submitted as part of the Contractor's installation plan. There shall be no rotation of the leveling nut during this procedure.

7. An additional nut shall be installed and tightened against the top nut to lock the installation. This lock nut shall be prepared and tightened as defined in no. 5 and no. 6 above. There shall be no rotation of the lower top nut during this procedure.

TABLE 1 – ANCHOR BOLTS

Anchor Bolt Size (inches)	Required Torque (±5%) (ft•lbs)
1 ½	650
1 ¾	1,000
2	1,500
2 ¼	2,200
2 ½	3,000

H. Bolting. Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of NYSDOT Specification Section 715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of NYSDOT Specification Section 719-01, Galvanized Coatings and Repair Methods. Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made *by first tightening all nuts and bolts sufficiently to bring all components into full contact* with each other. Any gaps between the faying surfaces after snug tightening that exceed 1/16 inch shall not be considered in full contact and shall be cause for rejection. The Contractor may propose remediation measures subject to approval by the Engineer. Rejected components shall be replaced or repaired at no cost to the Authority. Bolts shall not be fully tightened before said tolerances are checked. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by *Table 1001.5b of the New York State Steel Construction Manual. Fasteners shall be* inspected after installation in accordance with Section 1001.6 of the New York State Steel Construction Manual.

I. Welding. Field welding shall not be permitted on any part of the structure, except as shown on the Contract Plans and approved by the Engineer.

J. Galvanized Metal Repair. The Contractor shall repair any damage to galvanized surfaces in conformance with the field repair requirements specified in NYSDOT Specification Section 719-01, Galvanized Coatings and Repair Methods, except that zinc paint applied by the spray method shall not be permitted.

END OF SECTION

SECTION 05170

TOLL GANTRY

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05170A01 Complete steel space frame canopy system design, fabrication, including superstructure layout, construction drawings and specifications - signed and sealed by a Professional Engineer licensed in the State of New York.

05170A02 Completed steel post support system fabrication shop and construction drawings coordinated with the space frame canopy and foundation drawings.

05170A03 Space frame canopy and steel post support system erection drawings and lift plan - signed and sealed by a Professional Engineer licensed in the State of New York. Includes details of the methods of erection, lifting and sequence, and types of equipment to be used: slings, supports; etc:.

Catalog Cuts

05170B01 Catalog cuts for all products and components to be used in the system including: Product name, manufacturer, details, manufacturer's specifications and certified test data/analysis of each product.

Samples

05170C01 One (1) sample full size "node" with connecting member having the specified finish.

Product Data

05170D01 Product data showing compliance with galvanizing of components requirements.

05170D02 A complete "Products List", listing all products to be used including: product name, manufacturer, catalog cuts, details, samples (if requested by the Engineer), manufacturer's specifications and certified test data/analysis of each product.

Certificates

05170E01 The manufacturer must certify in writing for each element that the materials/ products to be used have been tested in accordance with a certified quality assurance program, and found to be satisfactory for the intended use by these contract documents.

05170E02 The manufacturer must certify in writing that the installer/erector of the space frame is approved by the space frame manufacturer, or is being erected under the direction of an approved technical advisor of the space frame manufacturer.

05170E03 The space frame canopy and steel post support fabricator shall submit evidence of welder"s certification in accordance with NYSDOT requirements.

Manufacturer Test Reports

05170F01 Testing reports of the materials used in the space frame canopy and steel post support system.

Construction and Installation Procedures

05170G01 The Contractor shall submit as part of his installation plan the sequence to "snug" tight the nuts on the anchor bolts as part of the space frame canopy and steel post installation and leveling sequence.

05170G02 The Contractor shall submit as part of his installation plan the sequence to final tightening of the nuts on the anchor bolts as part of the space frame canopy and steel post installation and final leveling sequence.

Calculations

05170H01 Complete space frame canopy analysis, design and construction calculations - signed and sealed by a Professional Engineer licensed in the State of New York.

05170H02 Space frame canopy and steel post support system erection and lift plan calculations - signed and sealed by a Professional Engineer licensed in the State of New York. Includes calculations that demonstrate the details of the methods of erection, lifting and sequence, and types of equipment to be used, slings, temporary supports, etc., do not cause a condition of overstress to the structural framing system or components.

Qualifications

05170K01 Qualifications of the space frame canopy manufacturer and its workers performing the design and fabrication work.

05170K02 Qualifications of the entity and its workers performing the erection of the space frame under the direction of a technical advisor of the space frame manufacturer.

05170K03 Qualifications that the Fabricator is certified in accordance with AISC Constructions Quality Certification program in the simple steel bridge structures category or equivalent program acceptable to the Engineer.

Record Documents

05170M01 Completed as-built record set of drawings and approved catalog cuts, signed and sealed by an Engineer registered in the State of New York.

Inspection Reports

05170O01 A full field final in-depth inspection of the completed space frame canopy and steel support system, and certified by the manufacturer that the finished product has been fabricated and erected in accordance with the manufacturer"s approved drawings and the contract documents.

Contact Information

05170P01 Contact information of the space frame canopy structure manufacturer/fabricator in accordance with NYSDOT Specification Section 106-01.

Permits

05170T01 Contractor shall obtain permit from the Authority for any operation during erection and lifting that requires roadway or lane closure of the Bayonne Bridge.

END OF APPENDIX "A"

DIVISION 5

SECTION 05210

STEEL JOISTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for steel joists. For this Section steel joists shall be taken to mean open web, steel joists, longspan and deep longspan steel joists, and joist girders. Types, quantities and sizes are shown on the Contract Drawings.

1.02 REFERENCES

American Institute of Steel Construction (AISC)

Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts

American Welding Society (AWS)

D.1.1 Structural Welding Code, Steel

Steel Joist Institute (SJI)

Standard Specifications for Steel Joists and Joist Girders

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Shop Drawings

B. For steel joists shown on the Contract Drawings prepare detailed shop drawings, including joists and erection drawings showing erection marks, SJI designation numbers, complete geometry of each joist including chord and web member sizes, locations and spacing; bearing plate layouts; bridging details and connections; shop coating; and any other details necessary for installation. Shop drawings shall be signed and sealed by a Professional Engineer licensed in the State in which the Work is to be performed.

C. Erection Drawings

The erection drawings shall include plans showing exact locations of joists, base and bearing plates, and/or bolts and other embedded items. All field-bolted connections, not specifically shown on shop drawings, shall be shown on erection drawings.

1.04 QUALITY ASSURANCE

A. The manufacturer shall certify that the design and fabrication of the steel joists to be installed under this Section are in accordance with SJI "Standard Specifications".

B. The Contractor shall quality welding processes and structural welding operators in accordance with AWS Structural Welding Code.

C. The Engineer reserves the right to perform Quality Assurance audits to ensure quality workmanship at the fabrication shop.

1.05 DELIVERY, STORAGE AND HANDLING

Deliver, store and handle steel joists as recommended in SJI "Standard Specifications". Handle and store joists in a manner to avoid deforming and overstressing members and to protect shop finish.

1.06 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel

Steel shall comply with SJI "Standard Specifications".

B. High Strength Threaded Fasteners

Fasteners shall be ASTM A 325 or A 490 heavy hexagonal structural bolts as shown on the Contract Drawings, with nuts, and hardened washers.

C. Shop Prime Painting and Surface Preparation.

1. Shop prime painting and surface preparation shall be as shown on the Contract Drawings.

2. Unless otherwise shown on the Contract Drawings shop prime paint surfaces that are scheduled to receive spray-on fireproofing.

D. Welding Electrodes: Comply with AWS D1.1.

2.02 FABRICATION

A. General

Fabricate steel joists in accordance with SJI "Standard Specifications".

B. Extended Ends, if any

Provide extended ends on joists where shown on the Contract Drawings. Comply with applicable requirements of SJI "Standard Specifications" and manufacturer's recommendations.

C. Ceiling Extensions, if any

Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suit manufacturer's standards, and of sufficient strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise shown on the Contract Drawings.

D. Bridging

1. Provide horizontal or diagonal type bridging for "open web" joists. Rods shall be used as bridging members.
2. Provide diagonal type bridging for longspan and deep longspan joists.
3. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

E. End Anchorage

Provide end anchorages to secure joists to adjacent construction, unless otherwise shown on the Contract Drawings.

PART 3. EXECUTION

3.01 ERECTION

A. General

Place and secure steel joists in accordance with SJI "Standard Specifications", approved shop drawings, and as herein specified.

B. Anchors

Furnish anchor bolts and other devices to be built into concrete and masonry construction under other Sections. Coordinate so the Work is not delayed.

C. Placing Joists

Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

D. Bridging

1. Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.
2. Provide temporary bridging, connections and anchors to ensure lateral stability during construction. Where "open web" joists lengths are 40 feet and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.

E. Fastening Joists

1. Coordinate drilling of holes in structural steel framework. Bolt joists to supporting steel framework in accordance with SJI "Standard Specifications" for type of joists used. Provide high-strength threaded fasteners for bolted connections of steel joists to steel columns and beams, and at other locations where shown on the Contract Drawings. Bolts shall be installed in accordance with AISC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". Anchor joists to concrete and masonry construction as required in accordance with approved shop drawings.

2. Field weld joists to supporting steel framework in accordance with the SJI "Standard Specifications" for type of joists used. Coordinate welding sequence and procedure with placing of joists. Welding shall be in accordance with AWS D1.1.

F. Touch-up Painting

Immediately after erection, clean field welds and damaged shop painted areas. Touch up using same paint as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 4.0 mils.

3.02 FIELD TESTS

A. Field welds shall be inspected by the Contractor in accordance with AWS D1.1.

B. *The Port Authority will perform quality assurance audits for all field tests.* The Contractor shall supply equipment and personnel, at no additional cost to the Authority to assist in the performance of the quality assurance audits.

END OF SECTION

SECTION 05210

STEEL JOISTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05210A01 Shop Drawings shall be prepared and submitted in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1.

05210A02 Erection Drawings shall be prepared and submitted in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1.

Certificates

05210E01 Submit a letter of certification from the steel joist manufacturer stating that the design and fabrication of the steel joists to be installed under this Section are in accordance with SJI "Standard Specifications".

END OF APPENDIX "A"

DIVISION 5

SECTION 05311

STEEL DECK

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for steel floor and roof deck.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Iron and Steel Institute (AISI)

Specification for the Design of Cold-Formed Steel Structural Members

American Welding Society (AWS)

D1.1	Structural Welding Code, Steel
D1.3	Structural Welding Code - Sheet Steel

American Society for Testing and Materials (ASTM)

ASTM A36	Specification for Structural steel
ASTM A108	Specification for Steel Bars, Carbon, Cold Finished, Standard - Quality
ASTM A611	Specification for Steel Sheet, Carbon, Cold Rolled, Structural Quality
ASTM A653	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

Steel Deck Institute (SDI)

Design Manual for Composite Decks, Form Decks, Roof Decks and Cellular Metal Floor Deck with Electrical Distribution (Publication No. 29).

Diaphragm Design Manual

Factory Mutual Engineering Corporation (FM)

1-28	Loss Prevention Data Sheet - Insulated Steel Deck

1.03 QUALITY ASSURANCE

A. The entity performing the Work of this Section shall have a minimum of five years experience in metal decking work involving complexities similar to those required under this Section and shall employ labor and supervisory personnel experienced in this type of Work.

B. The Contractor shall employ currently qualified welding processes and welding operators in accordance with AWS Specifications and shall provide certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.

C. Shear connector welds will be inspected and tested according to the requirements of AWS D.1.1 for stud welding. Contractor shall remove and replace work that does not comply with the specified requirements.

D. The composite behavior of floor deck shall be verified by tests as specified in SDI Publication No. 29. See Section 5 of the specifications for composite steel floor deck.

E. The composite behavior of cellular metal floor deck (for electrical distribution) with the concrete slab shall be verified by tests similar to that specified in SDI Publication No. 29. See Section 5 of the specifications for composite floor deck, also Sections 1 and 2 of the specifications for cellular metal floor deck. Where trench headers interrupt the composite action of concrete slab with metal deck, the deck shall be considered non-composite. The deck sheet shall be modified as required by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Do not bend or mar decking.

B. Store off ground with one end elevated for drainage.

C. Cover decking with waterproof material.

D. Do not store on roof or floor framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

E. Also see Section 3.02 "Protection".

1.05 SUBMITTALS

For Submittals see Appendix A.

PART 2. PRODUCTS

2.01 MATERIALS

The following materials shall conform to the types shown on the Contract Drawings. The types are indicated by the American Society for Testing and Materials (ASTM) or the Military Specifications Designation for each.

A. Steel for Painted Deck Units: ASTM A 611.

B. For composite floor deck use grades C and D. For non-composite floor deck and for roof deck use Grades C, D or E.

C. Steel for Galvanized Metal Deck Units: ASTM A653 SQ Grade 33.

D. Miscellaneous Steel Shapes: ASTM A 36.

2.02 ACCESSORIES

A. Shear Connectors, if any

Headed stud type, ASTM A 108, Grade 1015 or 1020, cold-finished carbon steel. AWS D1.1 Type B

B. Sheet Metal Accessories

Commercial quality, ASTM A 653, galvanized (coating designation G90).

C. T-toggles when their use is permitted by the Engineer.

2.03 FABRICATION

A. General

Form deck units in lengths to span three or more supports with flush, telescoped or nested 2-inch laps at ends and interlocking or nested side laps, unless otherwise shown on the Contract Drawings. The deck manufacture's design and fabrication shall be based on the total load stress limited to 20,000 psi for roof deck and 22,000 psi for floor deck. The live load deflection shall be limited to 1/360 of the span.

B. Metal Joint Cover Plates, if any

Fabricate metal joint cover plates of not less than the same thickness as decking for end-abutting floor deck units and at changes in direction. Form to match contour of deck units and to be approximately 6 inches wide.

C. Metal Closure Strips, if any

Fabricate metal closure strips, for cell raceways and openings between decking and other construction, of not less than 0.045-inch, minimum (18-gage) sheet steel unless otherwise shown on the Contract Drawings. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

D. Roof Sump Pans

Fabricate from single piece of 0.071-inch, minimum (14-gage) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown on the Contract Drawings. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3-inches wide. Recess pans not less than 1-1/2 inches below roof deck surface, unless otherwise shown on the Contract Drawings or required by deck configuration. Holes for drains shall be cut in field.

E. Tolerances

Fabrication tolerances for deck shall be in accordance with the provisions of SDI Publication No. 29.

2.04 SHOP PAINTING

A. Galvanizing: ASTM A 653, G 60 (Z 180) minimum.

B. Galvanizing Repair Paint

High zinc-dust content paint for damaged galvanized surfaces complying with Military Specifications MIL-P-21035 (Ships).

C. Coating for Exposed Galvanized Deck Surfaces

Where deck will remain exposed to view in the finished construction, the hot-dipped, zinc-coated deck shall be coated by the same entity that is to apply the prime coat and all subsequent coats.

D. Shop Prime Painting and Surface Preparation, if any

Shop prime painting and surface preparation shall be as shown on the Contract Drawings.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install deck units and accessories in accordance with manufacturer's recommendations and approved shop drawings, and as specified herein.
2. Coordinate the location of deck bundles with structural steel erector to prevent overloading of structural members.
3. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before permanently fastening. Do not stretch or contract side lap interlocks.
4. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.

5. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

6. Do not place deck units on concrete supporting structure until concrete has cured and is dry.

7. Minimum bearing length of deck on supporting members shall be 1-1/2 inches unless otherwise shown on the Contract Drawings.

B. Fastening Floor Deck Units

Fasten floor deck units to steel supporting members by not less than 3/4-inch diameter fusion welds spaced not more than 12 inches o.c. with a minimum of 2 welds per unit at each support. Side laps are to be welded with a maximum spacing of 36 inches on center. Tack weld at 4 feet o.c. for fastening end closures.

C. Fastening Roof Deck Units

Fasten roof deck units to steel supporting members by not less than 5/8-inch diameter fusion welds spaced not more than 12 inches o.c. at every support, and at closer spacing where required for lateral and uplift force resistance. Uplift resistance for the roof shall meet the requirements of class 1-90 rating in accordance with Factory Mutual (FM) Data Sheet 1-28. Side laps are to be welded with a maximum spacing of 36 inches on center. In addition; secure deck to each supporting member in ribs where side laps occur.

D. Alternative Fastening of Deck Units

Where shown on the Contract Drawings, an Engineer approved self tapping screw fastener may be used in lieu of fusion welds specified in 3.01 B and C above. Only one type of fastening method shall be used for the steel deck fastening.

E. Welding

Comply with AWS specifications requirements and procedures for appearance and quality of welds, and for methods used in correcting welding work. Use welding washers where recommended by deck manufacturer. Recommendations concerning the use of weld washers that appear in SDI Publication No. 29 shall be considered minimum requirements.

F. Cutting and Fitting

Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.

G. Reinforcement at Openings

Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other Work shown on the Contract Drawings.

H. Metal Joint Cover Plates, if any

Provide metal joint cover plates at abutting ends and changes in direction of floor deck units, except where taped joints are required.

I. Roof Sump Pans

Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches o.c. with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size shown.

J. Shear Connectors, if any

Weld shear connectors to supports through decking units in accordance with manufacturer's instructions. Do not weld shear connectors through two layers (lapped ends) of decking units. Weld only on clean, dry deck surfaces.

K. Closure Strips

Provide metal closure strips at open uncovered ends and edges of roof decking, and in voids between decking and other construction. Weld into position to provide a complete decking installation.

L. Touch-up Painting

After decking installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of deck units and supporting steel members. Touch up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions. Touch up painted surfaces with same type of shop paint used on adjacent surfaces. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces..

3.02 PROTECTION

A. Do not use deck units for storage or working platforms until permanently secured in position.

B. Assure that construction loads and concrete weight do not exceed acceptable levels indicated by the manufacturer's load tables. Such loads shall be limited so that the maximum sag is less than 1/180 of the span or 1/2 inch whichever is less.

C. No deck placed or stored shall be left unsecured at end of each day's Work. Deck units shall be secured from movement due to wind at all times.

END OF SECTION

SECTION 05311

STEEL DECK

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05311A01 As per Division 1 "Shop Drawings, Catalog Cuts and Samples". The shop drawings shall clearly indicate the dimensions, section properties, material types and finishes with ASTM designations, hardware, framing, laps, reinforcement, connections, anchorage, sump pans, cant strips, ridge and valley plates, closure strips, pour strips, factory installed knockouts and other details required by the Work of this Section. The preparation of these drawings shall be coordinated with the Work of other Sections.

05311A02 Layout of electrical distribution ducts and trenches in cellular metal floor.

Samples

05311C01 As per Division 1 "Shop Drawings, Catalog Cuts and Samples"; submit samples of the metal decking of sufficient size to show the materials, finishes, construction, connections, and workmanship involved in fabrication of the decking.

Product Data

05311D01 Test data, calculations or design charts for self tapping screws prepared by the screw manufacturer.

Certificates

05311E01 Submit a letter of certification from the deck manufacturer stating that the design and fabrication of the metal decking to be installed under this Section are in accordance with these specifications and SDI Design Manuals.

Construction and Installation Procedures

05311G01 Submit manufacturer's recommended installation instructions.

Qualifications

05311K01 The Contractor shall submit certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.

END OF APPENDIX "A"

DIVISION 5

SECTION 05350

HALF FILLED GRID DECK

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for metal fabrications, including but not limited to structural steel and iron shapes, plates and bars for half filled steel grid deck.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

American Society for Testing and Materials (ASTM)

ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A366	Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled (Withdrawn 2000)
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
ASTM A709	Structural Steel for Bridges
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM A955	Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
	American Welding Society, Inc. (AWS)
AWS D1.5	Bridge Welding Code

	Bridge Grid Flooring Manufacturers Association
BGFMA TS-01	Fabrication Tolerances for Grid Decks
BGFMA TS-03	Installation Tolerances and Guidelines for Grid Reinforced Concrete Bridge Decks

1.03 QUALITY ASSURANCE

Welding Qualification: Qualify welding processes and welding operators in accordance with AWS D1.5 "Bridge Welding Code ".

1.04 PERFORMANCE REQUIREMENTS

Design half filled grid deck to resist the following live load:

AASHTO 75 psf (distributed) pedestrian loading/AASHTO H15 Truck wheel load (without impact) and UBV truck (without impact), whichever controls. See Structural General Notes in the Contract Drawings for the definition of the UBV truck.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

1.06 JOB CONDITIONS

Coordination with Concrete Work: Where fabricated items or their anchors are to be embedded into concrete work, deliver such items to those performing the installation, together with coordination drawings and installation instructions.

PART 2. PRODUCTS

2.01 MATERIALS - GENERAL

Contractor shall furnish, deliver, and install the steel grid panels, any miscellaneous metal forms (or other related forming materials), reinforcing steel, and structural concrete as shown in the Contract Drawings and in accordance with the manufacturers' recommendations. All concrete required for this item shall be placed in the field.

Within 15 days after the contract is awarded, the Contractor shall notify the Engineer of the name, address, telephone number, and contact person of the steel grid fabricator of all deck panels to be manufactured, supplied, and installed.

2.02 STEEL GRID DECK SYSTEM

A. The steel grid deck system shall be obtained from one of the following AISC Simple Steel Bridge Structures (SBR) certified (minimum) and participating BGFMA members:

1. Bailey Bridges, Inc. (256) 845-7575
2. LB Foster (412) 875-3492
3. Clearspan Construction Products (412) 445-2765

4. Further information may be obtained from:

   BGFMA
   Attn: Mark Kaczinski
   300 East Cherry Street
   North Baltimore, OH 45872
   Tel: 1-877-257-5499
   Fax: 419-257-0332
   mkaczinski@dsbrown.com

B. The steel grid deck shall be fabricated using structural steel conforming to the requirements of ASTM A709 Grade 50, or ASTM A572 Grade 50.

1. Galvanized coatings shall conform to ASTM A123. Any defects in galvanizing shall be repaired as specified in ASTM A780. Repair materials containing aluminum shall not be used to restore defective areas.

2. Unless specified otherwise, leveling bolts, nuts, and washers shall conform to the specifications of ASTM A307, ASTM A563 and ASTM F844 respectively. Leveling bolts need not be galvanized if minimum top cover over the bolts of 2.5 inches is provided.

3. The vertical steel sheet metal form pans installed in the grid prior to galvanizing shall conform to the latest specification for ASTM A366 or A1011.

   a. Galvanized steel sheet metal forms installed following grid panel galvanizing shall conform to the latest specification for ASTM A653, furnished in the gauge specified on the Contract Drawings.

   b. All metal forms shall be protected during shipment and site storage to retain their shape until deck panel installation.

C. Reinforced steel in the concrete component to conform to Stainless steel alloy ASTM A955, Grade 75. The stainless steel shall be ASTM A276, UNS S32304.

2.03 LIGHT WEIGHT CONCRETE

Cast in place light weight concrete shall be used for the half filled grid deck. Coarse aggregate shall not exceed 3/8" in size and the concrete shall have a minimum compressive strength of 4500 psi. Refer to specification Section 03301, Portland Cement Concrete, Long Form.

2.04 FABRICATION - GENERAL

A. The steel grid deck shall be fabricated to the dimensions and properties as shown on the plans, shop drawings, and in accordance with Specifications.

B. Weld sizes shall be in conformance with established grid industry practice unless otherwise indicated on the Contract Drawings.

C. It shall be the Contractor's responsibility to field verify all dimensions in order to make necessary changes prior to fabrication. Due consideration shall be given to the placement of leveling devices to provide adequate clearance for their field adjustment from above using a socket wrench and for adequate clearance for field placement of headed shear studs.

D. After the attachment of edge bars, leveling devices, vertical form pans, and other components as described in the plans and specifications, the grid deck shall be galvanized in accordance with ASTM A123.

E. The dimensional tolerances for each steel grid panel shall be in accordance with the most recent version of BGFMA TS-01, "Fabrication Tolerances for Grid Decks", published by the Bridge Grid Flooring Manufacturers Association, as follows:

F. The steel grid deck panels shall be fabricated within the following tolerances:

Panel Length (L)	±0.25"[6.4mm] (in the direction of main bar)
Panel Width (W)	+0, -0.125"[-3.2mm] (in the direction of cross bar)
Squareness (Diagonals 'D1' and 'D2')	$\lvert D1-D2 \rvert \leq 0.5$"[12.7mm]
Longitudinal Camber	0.003*L
Transverse Camber	0.004*W
Sweep (side bow) ('L' in feet, tolerance in inches) (See Note 1)	0.025*L (for L ≤ 40'-0") $0.00065*L^2$ (for L > 40'-0")
Main Bar Verticality	0.04*H ('H' = full bar height) (See Note 2)
Cross Bar Verticality	None
Bar Spacing (Main Bar & Cross Bar)	±0.125"[3.2mm] center to center (See Note 2)

Note 1: Sweep tolerances applicable for galvanized panels with standard puddle welds connecting components.

Note 2: No more than 1% of all locations can violate specified tolerance.

G. Sheet metal forms shall be installed in such a manner as to minimize leakage.

H. Lifting locations and lifting procedures shall be included on the shop drawing submission. Care shall be taken to avoid twisting of the panels or bending of the panels in the weak (perpendicular to main bar) direction

1. The use of multiple pick points is recommended.
2. Steel grid panels must be properly blocked with wood (with due regard to built-in panel camber) during transportation and storage in order to avoid distortion or other damage.

PART 3. EXECUTION

3.01 PREPARATION

A. Field Measurements:

Take field measurements prior to preparation of shop drawings and fabrication, where possible. Allow for trimming and fitting where taking filed measurements before fabrication is not possible.

B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, if any, which are to be embedded in concrete construction. Coordinate delivery of such items to the construction site.

C. Cambered tables may be used to offset distortion caused by the welding process. Puddle welds at the top of the panel shall join each intersection of main bars, cross bars, and supplemental/diagonal bars. The electrode shall follow a spiral pattern engaging all intersecting bars. The resulting weld shall be visually inspected to ensure the weld engages all intersecting bars; there are no signs of porosity; there is no undercutting from the weld; and that the resulting weld is visually neat and workmanlike.

D. The fabricator shall develop the layout and detail it on the shop drawings based on the guidance provided on Contract Drawing.

3.02 INSTALLATION

A. Installation shall be in accordance with this specification and the most recent version of BGFMA TS-03, "Installation Tolerances and Guidelines for Grid Reinforced Concrete Bridge Decks," published by the Bridge Grid Flooring Manufacturers Association. The steel grid deck panels shall be installed within the following tolerances:

1. Alignment: Main bearing bar misalignment between adjacent grid deck panels shall be no more than 1/2".
2. Gap: Distance between main bearing bars between adjacent grid deck panels shall be as specified, ±1/2".

B. Panels delivered to the job site shall be free from any defects and bearing the proper identifying marks. Check the panels for defects and identification. Repair or replace the grid panels or metal forms damaged during shipment and storage, to the satisfaction of the Engineer.

C. Position panels on the beams and align with adjacent panels. Measure from fixed points to avoid cumulative error. Adjustment to proper elevation shall be made through the use of the built-in leveling bolts if specified, or shims or other means. Square up panels as necessary.

D. After all haunch and miscellaneous forms have been installed, the Contractor shall install the welded headed shear studs to the steel stringers, girders, and/or floor beams as detailed on the plans through the openings provided in the deck panels. Alternatively, with careful layout and the Engineer's permission, studs may be installed prior to placing deck panels. A separate welding generator shall be used to furnish power to each stud gun in order to assure acceptable welds.

E. After all studs have been installed, the Contractor shall clean the top surface of all flanges before any concrete is placed, including breaking the ceramic ferrules around the welded studs.

F. Gaps between the main bars and the horizontal form pans shall be field sealed by the contractor with silicone caulk as required to prevent excessive concrete and grout leakage.

G. Concreting Operations

1. At haunches and areas of full-depth concrete, the Contractor shall seal the openings in the main bars using duct tape or other similar material prior to concrete placement. Seal the openings from the haunch or full-depth side.
2. No concrete shall be placed until all grid panels are in place on the bridge, and secured in proper position and all welded headed shear studs and reinforcing steel is installed.

3. Light weight concrete shall be placed, finished, and cured in accordance with Specification Section 03301.
4. A pencil vibrator shall be used in the haunch and full depth areas between grid panels to assure good consolidation.
5. The vertical surfaces of any construction joints shall be thoroughly coated with a Portland cement mortar bonding grout.
6. A worker with a high-pressure water hose shall be stationed under the deck during all concrete pouring and finishing work to wash any drips off of the structural steel. Care must be taken not to disturb the form pans in the grid deck with the high-pressure stream.
7. Damaged or defective concrete shall be repaired or replaced in accordance with Specification Section 03301.

END OF SECTION

SECTION 05350

HALF FILLED GRID DECK

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - General Provisions.

A. Shop Drawings.

Submit shop drawings for fabrication and erection of half filled grid deck, including plans, elevations, and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.

B. Samples.

Submit 2 sets of representative samples of materials and finished products as requested by the Engineer.

C. Product Data.

Manufacturer's specifications and installation instructions for products used in half filled grid deck fabrications, including galvanization.

D. Certificates/Qualifications.

Submit following Certificates:

1. Professional Engineer: Include experience qualifications.
2. Fabricator: Experience, in-service performance and capability qualifications.
3. Welder: Evidence of current AWS certification.

E. Design Calculations.

Submit design calculations signed and sealed by a Professional Engineer licensed in the states of New York and New Jersey, showing compliance with Design and Performance Requirement's loading criteria.

END OF APPENDIX "A"

DIVISION 5

SECTION 05400

COLD-FORMED METAL FRAMING AND SHEATHING SYSTEM (INTERIOR AND EXTERIOR CONSTRUCTION)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for interior and exterior load-bearing, and exterior non-load-bearing (curtainwall) cold-formed metal framing systems, including gypsum sheathing board and accessories.

B. Interior non-load-bearing framing and gypsum board is specified in Division 9 Section on gypsum drywall.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Iron and Steel Institute (AISI)
AISI/COS/ NASPEC	North American Specification for the Design of Cold-Formed Steel Structural Members.
AISI/COFS/GP	Standard for Cold-Formed Steel Framing – General Provisions.
	American Society for Testing and Materials (ASTM)
ASTM A 123	Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM B 117	Practice for Operating Salt Spray (Fog) Apparatus.
ASTM C 954	Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
ASTM C 955	Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
ASTM C 1007	Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
ASTM C 1177	Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
ASTM C 1278	Specification for Fiber-Reinforced Gypsum Panel.
ASTM C 1280	Application of Gypsum Sheathing.
ASTM C 1513	Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM E 119	Test Methods for Fire Tests of Building Construction and Materials.
ASTM E 699	Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code - Steel.
AWS D1.3	Structural Welding Code - Sheet Steel.
	The Society for Protective Coatings (SSPC)
SSPC-Paint 20	Paint Specification No. 20 - Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Criteria

Items requiring design computations shall be designed by the Contractor to comply with *AISI/COS/NASPEC, AISI/COS/GP, and applicable building codes.*

B. Fire-Resistance Rating

Where assemblies with fire-resistance ratings are shown on the Contract Drawings, provide materials and installations which are identical to those of applicable assemblies tested in accordance with ASTM E 119 by a fire testing agency acceptable to the Engineer.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A", submit design calculations for metal framing, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with the design and performance requirements specified in 1.03 A.

B. Testing Agency Qualifications

An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented in accordance with ASTM E 699.

C. Engineer Qualifications

A professional engineer who is legally qualified to practice in the jurisdiction where the Work is to be performed and who is experienced in providing engineering services of the type and complexity required for Work of this Contract.

D. Welding Standards

Comply with applicable provisions of AWS D1.1 *Structural Welding Code - Steel* and AWS D1.3 *Structural Welding Code - Sheet Steel.*

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification.

E. Single Source Responsibility

Obtain cold-formed metal framing from a single manufacturer and obtain gypsum sheathing board products from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal framing materials to construction site in the manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Protect metal framing from corrosion, deformation and other damage. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

B. Deliver gypsum sheathing board materials in the manufacturer's original packaging, legibly identified. Store flat and level, off ground and under cover, with provision for air circulation. Handle to prevent breakage and damage to board edges.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, furnish and install products by one of the following, or approved equal:

A. Cold-Formed Metal Framing

Clark Steel Framing Systems, Middletown, OH
Deitrich Metal Framing, Inc., div. of Worthington Industries Co., Pittsburgh, PA
Marino\WARE, South Plainfield, NJ
Super Stud Building Products, Inc., Astoria, NY

B. Gypsum Sheathing Board

BPB America Inc., Tampa, FL
G-P Gypsum Corp., Atlanta, GA
United States Gypsum Co., Chicago, IL

2.02 MATERIALS

A. Metal Framing Materials

1. Minimum base-metal steel thickness of 0.0538 inch (16 gage) and heavier components: Structural quality steel sheet with a minimum yield point of 40,000 psi or greater in conformance with structural design, complying with ASTM A 653.

2. Minimum base-metal steel thickness of 0.0428 inch (18 gage) and lighter components: Commercial quality steel sheet with a minimum yield point of 33,000 psi, complying with ASTM A 653.

3. Studs

Manufacturer's standard C-shape or punched channel steel studs of type, size, shape and thickness shown on the Contract Drawings with 1.675 inch flange width on C-shape and 1.365 inch flange width on punched channel, unless otherwise shown.

4. Track

Same thickness as corresponding steel studs, sized to match, solid web. Track style, size and thickness for joists shall be as recommended by the joist manufacturer.

5. Joists

Manufacturer's standard C-shape sections of size and thickness as shown on the Contract Drawings.

6. Mark components to identify manufacturer, thickness and yield strength.

7. Finish

Galvanized finish on system components, including stud, track, joist, bridging and framing accessories, complying with ASTM A 653 for minimum G60 coating.

B. Framing Accessories

1. Bracing, blocking, bridging, clips and gusset plates shall be as shown on the Contract Drawings or as required by design using manufacturer's standard shapes. Hot-dip galvanize per ASTM A 123.

2. Fastenings: Type or combination of types per approved framing design and connection details.

   a. Manufacturer's standard self-drilling self-tapping screws: ASTM C 1513. Where installed underneath sheathing, provide low-profile type fastener head.

   b. Anchor bolts, nuts and washers: Hot-dip galvanized.

3. Anchorage devices: Drilled expansion bolts.

4. Galvanizing Repair Paint

SSPC-Paint 20, with dry film containing minimum of 94 percent zinc dust by weight.

   a. "Cold Galvanizing Compound", manufactured by Z.R.C. Worldwide, Quincy, MA, or approved equal.

C. Exterior Sheathing System

1. Gypsum Sheathing Board: Regular, 1/2-inch thick, or type and thickness as shown on the Contract Drawings, square edge, for exterior use with water resistant treated core, eligible for 6 month in-place manufacturer warranty against damage due to weather exposure, conforming to the following:

   a. Glass Mat Gypsum Sheathing: ASTM C 1177.

   b. Fiber-Reinforced Gypsum Sheathing: ASTM C 1278.

   c. Products: Subject to compliance with requirements of this Specifications Section, furnish and install one of the following products:

      DensGlass Gold Exterior Guard; G-P Gypsum Corp., Atlanta, GA
      GlasRoc Sheathing; BPB America Inc., Tampa, FL
      Fiberock Sheathing with Aqua-Tough; United States Gypsum Co., Chicago, IL

      (1) Where fire rated Work is shown on the Contract Drawings: Type X, 5/8 inch thick.

2. Gypsum or other board product for interior walls and partitions shall be as specified in Division 9 Section on gypsum drywall.

3. Sheathing Fasteners

ASTM C 954, steel drill screws, Type S-12 fluted tip, minimum 1-1/4 inches long, with organic-polymer coating or other corrosion-protective coating having a salt-spray resistance of more than 700 hours in accordance with ASTM B 117.

4. Sheathing Joint Treatment

Sheathing tape or sealant as recommended by the gypsum sheathing board manufacturer, specifically designed and manufactured to seal joints in sheathing against water and air infiltration. Tape shall be formulated with an adhesive that permanently bonds to sheathing substrates.

5. Felt (Building Wrap)

15 lb. asphalt saturated rag felt, non-perforated, ASTM D 226, Type I. Screws and washers for installation of felt shall be corrosion resistant, sized to penetrate sheathing and steel framing by at least three exposed threads.

6. Vapor Retarder

Reinforced polyethylene vapor retarder with manufacturer recommended joint tape and fasteners where shown on the Contract Drawings, or vapor retarder type as otherwise shown.

2.03 FABRICATION

A. General

1. Studs, track, bracing and bridging shall be manufactured per ASTM C 955.
2. System components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion in any member.

B. Fastenings

Attach similar components by welding. Attach dissimilar components by welding, bolting or screw fasteners, as recommended by the manufacturer.

C. Fabrication Tolerances

Fabricate assemblies to a maximum allowable tolerance variation from plumb, level and true to line of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Maximum out-of-square tolerance of 1/8 inch.

PART 3. EXECUTION

3.01 EXAMINATION

Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

Coordinate framing installation with sprayed-on fireproofing application, if any, to avoid disturbing or damaging fireproofing material.

3.03 INSTALLATION

A. General

1. Install cold-formed metal framing in accordance with the more stringent of AISI's *Standard for Cold-Formed Steel Framing – General Provisions* and manufacturer's written instructions.
2. Fastening type, size, spacing and penetration shall be as detailed per design on approved Shop Drawings.
3. As framing Work progresses, fill voids that will become inaccessible with insulation, sound attenuation or other materials shown on the Contract Drawings.
4. Wire tying of framing components and splicing of axially loaded studs is not permitted.
5. Cut framing members by sawing or shearing; torch cutting is not permitted.

B. Runner Track

Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Securely anchor tracks to supporting structure at corners and ends. Fasten as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches on center spacing for nail or power-driven fasteners, or 16 inches on center for other types of attachment.

1. Ensure complete, uniform and level bearing support for the bottom track at each stud location. If not provided, install full size load-bearing, high-density plastic shims below bottom track at stud locations as needed, or set bottom track in nonmetallic, nonshrink grout.
2. At intersecting or abutting track joints, securely anchor abutting pieces of track to a common structural element or splice pieces of track together.
3. Secure studs to top and bottom runner tracks by either welding or screw fastening at both flanges.

C. Steel Studs

1. Place and secure steel studs in accordance with ASTM C 1007.
2. Do not start placement of steel studs until supporting Work is in place and secure. Install temporary bridging, connections and anchors as required to ensure lateral stability during construction.
3. Set studs plumb, spaced 16 inches on center, unless otherwise shown on the Contract Drawings, without splices between connection points.

4. Install horizontal stiffeners in stud system, spaced not more than 48 inches on center vertically, or as otherwise shown on the Contract Drawings. Weld at each intersection.

D. Openings

1. Framed wall openings shall include a header and either multiple or heavier studs at each side of the openings, as shown on the approved Shop Drawings.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding. Space jack studs same as full-height wall studs. Secure stud system to wall opening frame as shown on the Contract Drawings.
3. Frame floor openings that are larger than the joist spacing.

E. Joints

Frame both sides of expansion and control joints with a separate stud where required for wall system. Do not bridge joints with components of stud system.

F. Joists

1. Install continuous rim track sized to match joists.
2. Install joists plumb, fastened to both flanges of track, complete with bracing and reinforcing as shown on approved Shop Drawings. Ensure minimum 1-1/2 inch end bearing.
3. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section or as otherwise recommended by joist manufacturer.
4. Where required, reinforce joists at interior supports with single short length of joist section located directly over interior support, snap-on shoe, 30 percent side-piece lapped reinforcement or other method recommended by joist manufacturer.
5. Secure joists to interior support systems to prevent lateral movement of bottom flange of joist.

G. Exterior Sheathing System

Apply gypsum sheathing board where shown on the Contract Drawings, in accordance with ASTM C 1280 and the following:

1. Screw sheathing to metal framing with screws placed 3/8 inch from board edges and ends. Space fasteners 8 inches on center or tighter as recommended by sheathing manufacturer, or as required for fire-resistance rated application. Fasteners heads shall bear tightly against the sheathing face, without cutting in or breaking the sheathing face or fracturing the sheathing core.
2. Do not bridge control or expansion joints with sheathing.
3. Seal sheathing joints with sheathing tape or sealant per sheathing manufacturer's instructions, except where sheathing is overlaid with an air barrier, vapor retarder or a full layer of insulation.
4. Protection of Sheathing
   a. Instead of sheathing tape or sealant and where shown on the Contract Drawings or required by code, apply felt to sheathing with corrosion resistant screws and washers spaced as recommended by gypsum sheathing board manufacturer. Lap felt 2 inches horizontally, shingle fashion, and 8 inches at end laps. Install felts smooth, without bulges, free of buckling, but not stretched tight.

b. For slanted wall applications, if any: After sheathing is in place, apply felt to slanted walls with corrosion resistant screws and washers spaced as recommended by gypsum sheathing board manufacturer, installed per 3.03 G.4.a.

c. Temporary protection for exposed wall ends: Apply felt as above at wall ends and other locations as required to temporarily protect cavity from water infiltration.

3.04 ADJUSTING

A. Field Painting: Touch up protective coatings damaged during welding, handling and installation. Comply with ASTM A 780 and use galvanizing repair paint for galvanized surfaces.

END OF SECTION

SECTION 05400

COLD-FORMED METAL FRAMING AND SHEATHING SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05400A01 Shop drawings for special components and installations not fully dimensioned or detailed in the manufacturer's product data. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate welds, type and location of mechanical fasteners, anchorage, supplemental strapping, bracing, splices, accessories, and details required for complete installation.

Product Data

05400D01 Manufacturer's product information and installation instructions for each item of steel stud system and accessories, and gypsum sheathing.

05400D02 Submit one copy of US Department of Labor Material Safety Data Sheets (MSDS) for galvanizing repair paint and sealing compound of 2.02 B.4 and 2.02 C.5 of this Section respectively.

Certificates

05400E01 Mill certificates signed by manufacturers of cold-formed metal framing certifying that their products comply with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, and galvanized-coating thickness. In lieu of mill certificates, submit test reports from a qualified independent testing agency evidencing compliance with requirements.

05400E02 Submit certification that field welding will be performed by personnel who have satisfactorily passed AWS qualification tests for Work similar to Work specified in this Section.

Calculations

05400H01 Provide calculations for loads and stresses of framing or trusses, sealed by a Professional Engineer registered in the state where the Work is to be erected, where required by the Contract Drawings.

END OF APPENDIX "A"

05400

DIVISION 5

SECTION 05506

MISCELLANEOUS STEEL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for metal fabrications, including but not limited to structural steel and iron shapes, plates, bars, tubes and pipe.

B. Items specified in this Section include but are not limited to the following, where shown on the Contract Drawings:

1. Loose steel lintels.
2. Shelf angles.
3. Ladders and safety cages.
4. Floor plates.
5. Nosings and treads.
6. Pipe bollards.
7. Miscellaneous steel framing and supports.
8. Arch chord fences with gates

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI A 14.3	Safety Requirements for Fixed Ladders.
	American Society of Mechanical Engineers (ASME)
ASME B 18.2.1	Square and Hex Bolts and Screws, Inch Series.
ASME B 18.6.1	Wood Screws (Inch Series).
ASME B 18.6.3	Machine Screws and Machine Screw Nuts.
ASME B 18.21.1	Lock Washers (Inch Series).
ASME B 18.22.1	Plain Washers.
	American Society for Testing and Materials (ASTM)
ASTM A27	Specification for Steel Castings, Carbon, for General Application.
ASTM A36	Specification for Carbon Structural Steel.
ASTM A47	Specification for Ferritic Malleable Iron Castings.
ASTM A48	Specification for Gray Iron Castings.
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A563	Specification for Carbon and Alloy Steel Nuts.
ASTM A780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM A786	Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
ASTM A1011	Specification for Sheet, Steel and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
ASTM C1028	Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
ASTM C1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
ASTM D1187	Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
ASTM E488	Test Method for Strength of Anchors in Concrete and Masonry Elements.
ASTM E935	Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
ASTM F568M	Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
ASTM F593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ASTM F594	Specification for Stainless Steel Nuts.
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.
AWS D1.3	Structural Welding Code – Sheet Steel.
	Code of Federal Regulations (CFR)
29 CFR Part 1910, Subpart D	Fixed Ladders.
	The Society for Protective Coatings (SSPC)
SSPC-Paint 20	Paint Specification No. 20 – Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
SSPC-SP 3	Surface Preparation Specification No. 3 – Power Tool Cleaning.
SSPC-SP 6	Surface Preparation Specification No. 6 – Commercial Blast Cleaning.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Ladders: When installed, if any, shall comply with the following minimum requirements for structural performance, unless otherwise shown on the Contract Drawings:

1. Treads and Platforms: Capable of withstanding a uniform load of 100 lbs. per sq. ft. and a concentrated load of 300 lbs., so located as to produce maximum stress conditions.

2. Handrails and Toprails: Capable of withstanding the following loads applied as indicated below:

   a. Uniform load of 50 lbs. per linear ft. applied simultaneously in both vertical and horizontal directions.

   b. Concentrated load of 200 lbs. applied at any point in any direction when tested per ASTM E 935.

   c. Uniform and concentrated loads above need not be assumed to act concurrently.

3. Guards: Intermediate rail balusters and panel fillers capable of withstanding a horizontal uniform load of 50 lbs. per sq. ft. of gross area of guard, including open areas of which they are part, of fabrication required or as shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A", submit design calculations for ladders, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

B. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for Work of this Contract with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.

C. Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where construction site is located and who is experienced in providing engineering services required for applications shown on the Contract Drawings.

D. Welding Standards: Comply with applicable provisions of AWS D1.1 *Structural Welding Code – Steel* and AWS D1.3 *Structural Welding Code – Sheet Steel.*

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabricating. Show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Ferrous Metals

1. Metal Surfaces: For fabrication of Work exposed to view, use materials that are smooth and free of surface blemishes including pitting, roughness, seam marks, roller marks and rolled trade names.
2. Steel Plates, Shapes and Bars: ASTM A36.
3. Rolled Steel Floor Plates: ASTM A786.
4. Steel Bar Grating: ASTM A1011 or ASTM A36.
5. Steel Tubing: ASTM A500, cold-formed; or ASTM A501, hot-rolled; for exterior installations. Steel tubing shall be hot-dip galvanized coated per ASTM A53.
6. Steel Pipe: ASTM A53; type and grade (if applicable) as selected by fabricator and as required for design loading; Schedule 40 (standard weight), unless otherwise shown on the Contract Drawings; black finish, unless galvanized coating is shown on the Contract Drawings.
7. Brackets, Flanges and Fittings: Cast or formed metal of the same type material and finish as supported construction.
8. Gray Iron Castings: ASTM A48, Class 30.
9. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47 Grade 32510, or cast steel, ASTM A27. Furnish bolts, washers and shims as required, hot-dip galvanized per ASTM A153.

B. Fasteners

1. General
   Zinc-Plated: ASTM B633, Class Fe/Zn 25 (Service Condition 4–very severe) for exterior use and Class Fe/Zn 8 (Service Condition 2–moderate) where built into exterior walls. Select fasteners for type, grade and class required for application shown on the Contract Drawings.
2. Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563, and where indicated, flat washers.
3. High Strength Bolts: ASTM A325 Type 1 Surface Type A, threads are to be excluded from shear planes.
4. Machine Screws: ASME B18.6.3.
5. Lag Bolts: ASME B18.2.1.
6. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
7. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
8. Plain Washers: Round, carbon steel, ASME B18.22.1.
9. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   a. Interior Locations: Carbon steel components zinc-plated complying with ASTM B633, Class Fe/Zn 8.

b. Exterior Locations: Alloy Group 1 stainless steel bolts complying with ASTM F593 and nuts complying with ASTM F594.

10. Welding Electrodes: Comply with AWS D1.1 and D1.3.

C. Paint

1. Shop Primer for Ferrous Metal: Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Contract Drawings. Comply with applicable requirements of Division 9 Section on Painting.

2. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

3. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

D. Grout: Pre-mixed, factory-packaged, non-shrink type, complying with ASTM C1107, as manufactured by one of the following, or approved equal, for specified application:

1. Non-Metallic

a. "Five Star Grout", Five Star Products, Inc., Fairfield, CT

b. "Masterflow 713 Plus", Master Builders, Inc. (Degussa), Cleveland, OH

c. "NS Grout", Euclid Chemical Co., Cleveland, OH

2. Metallic

a. "Embeco 636 Plus", Master Builders, Inc. (Degussa), Cleveland, OH

b. "Five Star Metallic Grout", Five Star Products, Inc., Fairfield, CT

c. "NS Metallic Grout", Euclid Chemical Co., Cleveland, OH

3. Use metallic grout in concealed locations where not exposed to moisture. Use non-metallic nonstaining grout in exposed, wet and exterior locations, unless otherwise shown on the Contract Drawings.

2.02 FABRICATION

A. General: Fabricate items to sizes, shapes, profiles and dimensions required for application shown on the Contract Drawings or approved Shop Drawings, using proven details of fabrication and support. Use materials of type and thickness shown on the Contract Drawings or specified in this Section for various components of Work or, if not shown, as required to produce strength and durability in finished product for intended use.

1. Shop Assembly: Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark units for reassembly and coordinated installation.

2. Form exposed Work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of 1/32 inch, unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

3. Weld corners and seams continuously, complying with AWS D1.1 and D1.3 recommendations as applicable. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

4. Form exposed connections with hairline joints flush and smooth, using concealed fasteners wherever possible. Exposed fasteners, where used, shall be of type as shown on the Contract Drawings or, if not shown, Phillips flathead (countersunk) screws or bolts.

5. Fabricate joints that will be exposed to weather in a manner to exclude water, or with weep holes where water may accumulate.

6. Cut, drill and tap units to receive anchorage, hardware and similar items.

7. Furnish anchorage of type shown on the Contract Drawings, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use and for design loads. Furnish steel washers, except that where heads and nuts bear on wood structural connections, furnish malleable-iron washers.

8. Galvanizing: Zinc coating by the hot-dip process for items shown on the Contract Drawings or specified in this Section to be galvanized. Coating thickness shall be as specified in the referenced standards.

   a. Rolled, pressed and forged iron and steel shapes, castings, plates, bars and strip 1/8 inch thick and heavier and assembled fabrications: ASTM A123.

   b. Iron and steel hardware: ASTM A153.

B. Steel Ladders

1. Fabricate ladders for locations shown on the Contract Drawings, with dimensions, spacings, details and anchorages as shown. Comply with requirements of ANSI A 14.3 or OSHA 29 CFR 1910, whichever is more stringent.

   a. Side rails shall be 1/2 inch by 2-1/2 inches continuous structural steel flat bar with eased edges, spaced 18 inches apart, unless otherwise shown.

   b. Bar rungs shall be 3/4-inch diameter solid structural steel, spaced 12 inches on center.

2. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

3. Top surface of each rung shall be non-slip; either coat the rung with aluminum oxide (corundum) granules set in epoxy resin adhesive or use a type of manufactured rung that is filled with aluminum oxide grout.

4. Support each ladder at top and bottom and at equally spaced intermediate points, so that no unsupported length of ladder shall exceed 5 feet. Use welded or bolted steel brackets, designed for adequate support and anchorage and to hold ladder clear of the wall surface with a minimum 7-inch clearance from wall to centerline of rungs.

5. Extend rails 42 inches above top rung and return rails to wall or structure, unless other secure handholds are furnished. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure for secure ladder access.

6. Galvanize ladders, brackets and fasteners.

7. Ship's Ladders: Fabricate of open type construction with structural steel channel or steel plate stringers, pipe handrails and open steel grating treads, unless otherwise shown on the Contract Drawings. Furnish brackets and fittings necessary for installation.

C. Ladder Safety Cages: Fabricate from structural steel flat bars, assembled by welding. Comply with requirements of ANSI A 14.3 or OSHA 29 CFR 1910, whichever is more stringent.

1. Top and bottom primary hoops shall be 5/16 inch by 4-inch bar.

2. For cages longer than 20 feet, space intermediate hoops not more than 4 feet on center from 5/16 inch by 2-inch bar between the primary hoops.

3. Vertical flat bars 5/16 inch by 2 inches shall be secured to each hoop at maximum 9-1/2 inches on center, unless otherwise shown on the Contract Drawings.
4. Secure assembled safety cage to ladder rails and adjacent construction shown.
5. Galvanize ladder safety cages and fasteners.

D. Loose Bearing and Leveling Plates: For steel items bearing on masonry or concrete construction, flat, free from warps or twists and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

E. Loose Steel Lintels
1. Fabricate from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
2. Weld adjoining members together to form a single unit where shown on the Contract Drawings.
3. Size loose steel lintels for equal bearing of 1 inch per foot of clear span, but not less than 8 inches bearing at each side of openings, unless otherwise shown on the Contract Drawings.
4. Galvanize loose steel lintels located in exterior walls.

F. Shelf and Relieving Angles
1. Fabricate from steel angles of sizes indicated and for attachment to concrete framing. Fabricate with slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches on center, unless otherwise shown on the Contract Drawings.
2. Miter and weld corners. Provide open joints at expansion and control joints. Joint width shall be 2 inches larger than expansion or control joint.
3. Galvanize shelf and relieving angles located in exterior walls.

G. Miscellaneous Framing and Supports
1. Furnish miscellaneous steel framing and supports not part of structural steel framework, as required by the Contract Drawings to complete the Work.
2. Fabricate miscellaneous units as shown on the Contract Drawings or, if not shown, of required dimensions to receive adjacent other Work to be retained by framing. Fabricate from structural steel shapes, plates and bars of welded construction using mitered joints for field connection, except as otherwise shown on the Contract Drawings.
3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Space anchors 24 inches on center and furnish minimum anchor units of 1-1/4 inch by 1/4 inch by 8 inch steel straps, except as otherwise shown on the Contract Drawings.
4. Fabricate support for suspended toilet partitions as follows:
   a. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C8 by 11.5 channels or another shape with equivalent structural properties.
   b. Hangers: Steel rods, 1/2-inch minimum diameter, spaced not more than 36 inches on center. Thread rods to receive anchor and stop nuts. Fit hangers with wedge-shaped washers for full bearing on sloping flanges of support beam.

c. Braces and Angles: Steel angles of size required for rigid support of beam and for secure anchorage.

5. Galvanize miscellaneous framing and supports at exterior locations and where shown on the Contract Drawings.

H. Miscellaneous Steel Trim

1. Fabricate units from structural steel shapes, plates and bars, with continuously welded joints and smooth exposed edges, unless otherwise shown on the Contract Drawings. Miter corners and use concealed field splices wherever possible. Furnish cutouts, fittings and anchorages as required for coordination of assembly and installation with other Work.

2. Galvanize miscellaneous steel trim at exterior locations. Galvanize miscellaneous steel trim at interior locations where shown on the Contract Drawings.

I. Floor Plate

1. Fabricate raised-pattern floor plates from rolled-steel floor plate of thickness and in pattern shown on the Contract Drawings.

2. Abrasive-Surface: Manufacturer's standard abrasive granules rolled into surface of steel plate where shown on the Contract Drawings. Coefficient of friction (COF) shall be 0.6 or higher when tested according to ASTM C1028.

3. Include steel angle stiffeners and fixed and removable sections with steel bar drop handles for lifting as indicated.

J. Extruded Nosings and Treads

1. Fabricate of material, color, sizes and configurations shown on the Contract Drawings. If not shown, fabricate cast-iron units with an integral abrasive finish. Lengths shall be as required to accurately fit each opening or conditions.

a. Integral abrasive filler shall consist of aluminum oxide (corundum), silicon carbide or a combination of both, in an epoxy resin binder.

b. Solid abrasive type units without ribs.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. American Safety Tread Co., Inc., Helena, AL

b. Balco Inc., Wichita, KS

c. Safe-T-Metal Co., Inc., Mineola, NY

d. Wooster Products Inc., Wooster, OH

3. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches on center, evenly spaced between ends, unless otherwise shown on the Contract Drawings. Use closer spacing if recommended by the manufacturer.

K. Cast Nosings, Treads and Thresholds

1. Fabricate units of material, color, sizes and configurations shown on the Contract Drawings. If not shown, furnish cast-iron units with an integral abrasive finish. Lengths shall be as required to accurately fit each opening or conditions.

a. Cast units with an integral abrasive grit consisting of aluminum oxide (corundum), silicon carbide or a combination of both.

b. Plain surface texture, except where fluted or cross-hatched surfaces are shown on the Contract Drawings.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. American Safety Tread Co., Inc., Helena, AL

b. Balco Inc., Wichita, KS

c. Safe-T-Metal Co., Inc., Mineola, NY

d. Wooster Products Inc., Wooster, OH

3. Furnish anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.

4. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches on center, evenly spaced between ends, unless otherwise shown on the Contract Drawings. Use closer spacing if recommended by the manufacturer.

L. Corner Guards: Fabricate from steel angles of sizes as shown on the Contract Drawings, but not less than 3 by 3 by 5/16 inch extending from floor to 42 inches above floor. Fabricate with 3/8 inch steel base plates for bolting to floor and with 1/4 by 2 inch steel strap braces at top. Furnish at least 2 vertical angles at each location along the length of the ladder where connections are made (except at internal corners), with strap extended between angles and from each angle to wall or column.

M. Wheel Guards: Fabricate from 3/4-inch thick, hollow-core, gray-iron castings of size and shape shown on the Contract Drawings. Fabricate with holes for countersunk anchor bolts and grouting.

N. Pipe Bollards.

1. Fabricate from Schedule 40 black steel pipe, unless otherwise shown on the Contract Drawings. Prime and finish with two coats of paint as specified in Division 9 Section on Painting. Cap bollards with 1/4-inch minimum steel plate finished to match pipe, unless indicated to be concrete filled.

2. Fabricate sleeves for bollard anchorage from steel pipe, matching shape and configuration of bollard and with outside dimensions not less than 3/4 inch greater than outside dimensions of bollard. Weld 1/4-inch thick steel plate closures to bottoms of sleeves. Plate closures shall be 1 inch greater in length and width than outside dimensions of sleeves.

3. Reflective marking tape, if any, shall be in color shown and as specified in Division 2 Section on removable retro-reflective pavement marking tape.

O. Arch Chord Fences: Metal mesh shall be plain carbon steel cut to match geometry of Arch Chord Fence or other supporting elements. Metal mesh panels shall be spot welded to Arch Chord Fence or other supporting elements as indicated on the Contract Drawings.

1. Finished arch chord fence assemblies shall be painted in accordance with Section 09910 - PAINTING. Any defects to arch chord fence assemblies after painting shall be repaired to the satisfaction of the Engineer.

2. Fabricate as indicated on the Contract Drawings and in accordance with 2.03A with additional fabrication tolerances as follows:

3. Plumbness: When the arch chord fence assemblies are erected in upright position, the out-of-plumb dimensions in both in-plane and out-of-plane directions measured between the top end and the bottom end of the arch chord fence assemblies shall not exceed 0.250 inch.

4. Flatness: The arch chord fence assemblies shall be free of any warp, bow, or twist. When the arch chord fence assemblies are laid onto a flat horizontal surface, any gaps between the arch chord fence assemblies frame and the surface shall not exceed 0.250 inch.

5. Straightness: For any straight members of the arch chord fence assemblies, the permissible variation for straightness shall be 0.125 inch times length of the member (in feet) divided by 5.

2.03 SHOP PAINTING

A. Surface Preparation: Prepare ferrous metal surfaces to comply with requirements for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications as follows:

1. Exterior: SSPC-SP 6.
2. Interior: SSPC-SP 3.

B. Apply shop primer to surfaces of metal fabrications, except those that are galvanized or shown on the Contract Drawings to be embedded in concrete or masonry, in compliance with requirements of SSPC-PA 1 for shop painting.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the construction site in time for installation.

3.02 INSTALLATION

A. Furnish and install anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of metal fabrications. Set Work accurately in location, alignment and elevation plus level, true and free of rack, measured from established lines and levels. Furnish and install temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

C. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS D1.1 and D1.3 for procedures of manual shielded metal-arc welding, appearance and quality of welds made and methods used in correcting welding Work.

E. Setting Loose Plates

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates or surfaces.

2. Set loose leveling and bearing plates on wedges or other adjustable devices. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.

F. Miscellaneous Framing and Supports: Install framing and supports in compliance with requirements of items being supported, including manufacturer's written instructions and requirements.

G. Supports for Toilet Partitions: Anchor supports securely to and rigidly brace from overhead building structure.

H. Nosings, Treads and Thresholds

1. Install with anchorage system indicated complying with manufacturer's recommendations.

2. Apply black bituminous coating to concealed bottoms, sides and edges of cast-iron units set into concrete.

3. Seal thresholds exposed to exterior with elastomeric sealant, complying with the applicable Division 7 Section on Sealants, for a watertight installation.

I. Wheel Guards: Anchor wheel guards to concrete or masonry construction complying with manufacturer's instructions. Fill cores solidly with concrete.

J. Bollards

1. Install bollards vertical to line and grade shown on the Contract Drawings.

2. Anchor bollards with 4 bolts through bottom plate with minimum 4 inch embedment into concrete, by core-drilling and grouting into concrete or by anchoring in place with concrete footings, as shown on the Contract Drawings.

3. Vibrate and tamp concrete to consolidate. Support and brace bollard until concrete has cured.

4. Seal joint between concrete footings and surrounding pavement and sidewalk in accordance with Division 2 Section on Pavement Joint Sealing.

3.03 ADJUSTING

A. Touch-Up Painting

1. Shop Painted Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces. Apply by brush or spray in a minimum dry film thickness of 2.0 mils.
2. Galvanized Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION

SECTION 05506

MISCELLANEOUS STEEL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data: Manufacturer's technical information, specifications, anchor details and installation instructions for miscellaneous steel products used, including grout and paint products.

B. Shop Drawings: For fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Furnish templates for anchor and bolt installation under other Sections if required.

C. Samples: Representative samples of materials, color, texture or design of finished products for nosings, treads and thresholds, if any.

D. Design Calculations: Submit design calculations signed and sealed by a professional engineer licensed in the state in which Work is to be performed, showing compliance with Design and Performance Requirements loading criteria.

E. Qualifications

1. Professional Engineer: Include experience qualifications.
2. Fabricator: Experience, in-service performance and capability qualifications.
3. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

DIVISION 5

SECTION 05510

METAL STAIRS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for metal stairs complete with steel pipe railings and handrails.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society of Mechanical Engineers (ASME)
ASME B 18.2.1	Square and Hex Bolts and Screws, Inch Series.
ASME B 18.6.3	Machine Screws and Machine Screw Nuts.
ASME B 18.21.1	Lock Washers (Inch Series).
ASME B 18.22.1	Plain Washers.
	American Society for Testing and Materials (ASTM)
ASTM A 27	Specification for Steel Castings, Carbon, for General Application.
ASTM A 36	Specification for Carbon Structural Steel.
ASTM A 47	Specification for Ferritic Malleable Iron Castings.
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A 153	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A 500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A 501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A 563	Specification for Carbon and Alloy Steel Nuts.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM A 1008	Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

ASTM A 1011	Specification for Sheet, Steel and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B 633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
ASTM C 1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
ASTM D 1187	Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
ASTM E 488	Test Methods for Strength of Anchors in Concrete and Masonry Elements.
ASTM E 935	Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
ASTM F 568M	Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
ASTM F 593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ASTM F 594	Specification for Stainless Steel Nuts.
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.
AWS D1.3	Structural Welding Code – Sheet Steel.
	The Society for Protective Coatings (SSPC)
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
SSPC-SP 3	Surface Preparation Specification No. 3 – Power Tool Cleaning.

1.03. DESIGN AND PERFORMANCE REQUIREMENTS

A. When installed, metal stair assemblies shall comply with the following minimum requirements for structural performance, unless otherwise shown on the Contract Drawings:

1. Treads and Platforms of Steel Stairs

   Capable of withstanding a uniform load of 100 lbs. per sq. ft. and a concentrated load of 300 lbs. per 4 sq. in., so located as to produce maximum stress conditions.

2. Handrails and Toprails of Guards

   Capable of withstanding the following loads applied as indicated when tested per ASTM E 935 and of transferring these loads through the supports to the structure:

   a. Uniform load of 50 lbs. per linear ft. applied simultaneously in both vertical and horizontal directions.
   b. Concentrated load of 200 lbs. applied at any point in any direction.
   c. Have attachment devices and supports to transfer these loads to the structure.
   d. Uniform and concentrated loads described above need not be assumed to act concurrently.

3. Guards

Intermediate rails, balusters and panel fillers capable of withstanding a horizontal uniform load of 50 lbs. per sq. ft. of gross area of guard, including open areas of which they are a part. Load need not be assumed to be acting concurrently with uniform horizontal loads on toprails of railing assembly in determining stress on guard supporting members.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A", submit structural calculations for metal stairs, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

B. Fabricator Qualifications

Firm experienced in producing metal fabrications similar to those indicated for Work of this Contract with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.

C. Engineer Qualifications

A professional engineer who is legally qualified to practice in jurisdiction where construction site is located and who is experienced in providing engineering services required for applications shown on the Contract Drawings. Engineering services are defined as those performed for installations of metal stairs that are similar to those shown on the Contract Drawings for Work of this Contract in material and design.

D. Metal Bar Grating Standards: Comply with requirements of applicable portions of NAAMM MBG 531.

E. Welding Standards

Comply with applicable provisions of AWS D1.1 *Structural Welding Code – Steel* and AWS D1.3 *Structural Welding Code – Sheet Steel.*

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification.

F. Field Measurements

Check actual locations of walls and other construction to which metal fabrications must fit, by taking accurate field measurements before fabricating. Show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

Protect material from damage, scratches, nicks, dents and gouges during delivery, storage, assembly and installation. Remove damaged material from the construction site and replace it at no cost to the Authority.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Ferrous Metals

1. Metal Surfaces: Smooth and free of surface blemishes including pitting, roughness, seam marks, roller marks and rolled trade names where exposed to view on finished stair surfaces.
2. Steel Plates, Shapes and Bars: ASTM A 36.
3. Steel Bar Grating: ASTM A 36.
4. Steel Wire Rod for Grating Crossbars: ASTM A 510.
5. Steel Tubing: Cold-formed, ASTM A 500; or hot-rolled, ASTM A 501.
6. Structural Steel Sheet: Hot-rolled, ASTM A 1011, or cold-rolled ASTM A 1008, Class 1; of grade required for design loading.
7. Steel Pipe: ASTM A 53; type and grade (if applicable) as selected by fabricator and as required for design loading; Schedule 40 (standard weight), unless otherwise shown on the Contract Drawings; black finish, unless galvanized coating is shown on the Contract Drawings.
8. Brackets, Flanges and Fittings: Cast or formed metal of the same type material and finish as supported rails, unless otherwise shown on the Contract Drawings.
9. Gray Iron Castings: ASTM A 48, Class 30.
10. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.
11. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47 Grade 32510 or cast steel, ASTM A 27. Furnish bolts, washers and shims as required, hot-dip galvanized per ASTM A 153.

B. Fasteners

1. General

   Zinc-Plated: ASTM B 633, Class Fe/Zn 25 (Service Condition 4–very severe) for exterior use and Class Fe/Zn 8 (Service Condition 2–moderate) where built into exterior walls. Select fasteners for type, grade and class required for application shown on the Contract Drawings.
2. Bolts and Nuts: Regular hexagon head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563, and where indicated, flat washers.
3. Machine Screws: ASME B18.6.3.
4. Lag Bolts: ASME B18.2.1.
5. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
6. Plain Washers: Round, carbon steel, ASME B18.22.1.
7. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   a. Interior Locations: Carbon steel components zinc-plated complying with ASTM B 633, Class Fe/Zn 8.

b. Exterior Locations: Stainless steel bolts complying with ASTM F 593, Alloy Group 1 or 2 and nuts complying with ASTM F 594.

C. Paint

1. Shop Primer for Ferrous Metal

Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Contract Drawings. Comply with applicable requirements of Division 9 Section on painting.

2. Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

3. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Grout

Pre-mixed, factory-packaged, nonshrink, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107. Furnish grout specifically recommended by the manufacturer for interior or exterior applications, as shown on the Contract Drawings.

E. Concrete Fill

1. Concrete Materials and Properties

Comply with the requirements of Division 3 Section on concrete for normal weight, ready-mix concrete with minimum 28-day compressive strength of 2500 psi, minimum 440 lbs. cement per cu. yd. and maximum water/cement (W/C) ratio of 0.65, unless higher strengths are shown on the Contract Drawings.

2. Non-Slip Aggregate Finish

Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rust-proof and non-glazing; unaffected by freezing, moisture or cleaning materials, where shown on the Contract Drawings.

2.02 FABRICATION

A. General

Fabricate units to sizes, shapes and profiles shown on the Contract Drawings or approved Shop Drawings. Fabricate from structural steel shapes, plates and steel bars of type, size and thickness as shown on the Contract Drawings or, if not shown, as required to produce strength and durability in finished product for intended use.

1. Shop Assembly: Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark units for reassembly and coordinated installation.
2. Use welded construction with mitered joints for field connections, except as otherwise shown on the Contract Drawings.
3. Weld corners and seams continuously, complying with AWS D1.1 recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

4. Form exposed Work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of 1/32 inch, unless otherwise shown on the Contract Drawings. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown on the Contract Drawings or, if not shown, Phillips flathead (countersunk) screws or bolts.

6. Provide weep holes where water may accumulate.

7. Cut, reinforce, drill and tap components to receive anchorage, finish hardware and similar items.

8. Furnish anchorage of type shown on the Contract Drawings, coordinated with the supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

9. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

10. Galvanizing

    Zinc coating by the hot-dip process for items shown on the Contract Drawings or specified in this Section to be galvanized. Coating thickness shall be as specified in the referenced standards.

    a. Rolled, pressed and forged iron and steel shapes, castings, plates, bars and strip 1/8-inch thick and heavier, and assembled fabrications: ASTM A 123.

    b. Iron and steel hardware: ASTM A 153.

B. Steel Framed Stairs

Construct stairs to conform to sizes and arrangements shown on the Contract Drawings and join pieces together by welding unless otherwise shown. Furnish complete stair assemblies including but not limited to metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates and other components necessary for the support of stairs and platforms and as required to anchor and contain the stairs on the supporting structure.

1. Stair Framing

   Fabricate stringers of structural steel channels or plates, or a combination thereof, as shown on the Contract Drawings. Furnish closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as shown on the Contract Drawings. Bolt or weld headers to stringers, newels and framing members to stringers and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.

2. Metal Pan Risers, Subtreads and Subplatforms

   Shape metal pans for risers and subtreads to conform to configuration shown on the Contract Drawings. Furnish thicknesses of structural steel sheet for metal pans shown but not less than required to support the total design loading.

   a. Form metal pans of cold-rolled carbon steel sheet, unless otherwise shown on the Contract Drawings.

b. Directly weld risers and subtreads to stringers. Locate welds on side of metal pans to be concealed by concrete fill.

3. Stair Railings and Handrails

Comply with requirements specified elsewhere in this Section for steel pipe railings and handrails and the following:

a. Fabricate newels of steel tubing and furnish newel caps of gray-iron castings, as shown on the Contract Drawings.

b. Railings may be bent at corners, rail returns and wall returns, instead of using prefabricated fittings.

c. Connect railing posts to stair framing by direct welding, unless otherwise shown on the Contract Drawings.

C. Steel Pipe Railings and Handrails

Fabricate steel pipe railings and handrails to design, dimensions and details shown on the Contract Drawings, formed of pipe of sizes and wall thickness shown on the Contract Drawings, but not less than required to support design loading.

1. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise shown on the Contract Drawings.

2. At tee and cross intersections provide coped joints.

3. At bends interconnect pipe by means of prefabricated elbow fittings or flush radius bends, as applicable, of radii shown on the Contract Drawings.

4. Return rails to wall at ends of wall-mounted handrails, except where otherwise shown on the Contract Drawings.

5. Close exposed ends of pipe by welding 3/16-inch thick steel plate in place or by use of prefabricated fittings.

6. Brackets, Flanges, Fittings and Anchors

Furnish wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other Work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry.

7. Toe Boards

Furnish toe boards at railings around openings and at the edge of open-sided floors and platforms where shown on the Contract Drawings. Fabricate to dimensions and details shown on the Contract Drawings or, if not shown, use 4 inch high by 1/8-inch thick continuous plate welded to, and centered between each railing post.

D. Cast Treads and Nosings

1. Fabricate units of material, color, sizes and configurations as shown on the Contract Drawings. If not shown, furnish cast-iron units with an integral abrasive finish. Lengths shall be as required to accurately fit each opening or conditions.

a. Cast units with an integral abrasive grit consisting of aluminum oxide (corundum), silicon carbide or a combination of both.

b. Plain surface texture, except where fluted or cross-hatched surfaces are shown on the Contract Drawings.

2. Manufacturers

Subject to compliance with the requirements of this Section, furnish and install cast treads and nosings from one of the following:

American Safety Tread Co., Inc., Helena, AL
Balco Inc., Wichita, KS
Barry Pattern & Foundry Co., Inc., Birmingham, AL
Safe-T-Metal Co., Inc., Mineola, NY
Wooster Products Inc., Wooster, OH

3. Furnish anchors for embedding units in concrete, either integral or applied to units, as recommended by the manufacturer.

E. Metal Bar Grating Treads and Platforms

1. Fabricate treads and platforms of steel bar grating where shown on the Contract Drawings, in sizes and finish shown, including carrier end plates provided with hole and slot for bolted attachment to stair stringers.
2. Fabricate using steel bar grating with cross bars and bearing bars in sizes, spacings and of fabrication method shown on the Contract Drawings. Cross bar and bearing bar spacing shall meet structural performance requirements.
3. Finish: Hot-dip galvanized or shop primed as shown on the Contract Drawings.
4. Traffic Surface: Plain, serrated, knurled or an applied abrasive finish consisting of aluminum oxide aggregate in an epoxy-resin adhesive, as shown on the Contract Drawings.
5. Fabricate treads and platforms with nosings where shown on the Contract Drawings, of material and surfacing shown. Weld grating platform to platform framing.

F. Miscellaneous Framing and Supports

1. Furnish miscellaneous steel framing and supports that are not a part of structural steel framework, as required to complete Work.
2. Galvanize miscellaneous frames and supports where shown on the Contract Drawings.

2.03 SHOP PAINTING

A. Surface Preparation

Prepare ferrous metal surfaces to comply with requirements of SSPC-SP 3.

B. Apply shop primer to surfaces of metal stairs except those that are galvanized or shown on the Contract Drawings to be embedded in concrete or masonry. Comply with requirements of SSPC-PA 1 for shop painting.

1. Stripe paint all edges, corners, crevices, bolts, welds and sharp edges.

PART 3. EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the construction site in time for installation.

3.02 INSTALLATION

A. Fastening to In-Place Construction

Furnish and install anchorage devices and fasteners where necessary for securing metal stairs to construction in-place at the construction site, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

B. Cutting, Fitting and Placement

Perform cutting, drilling and fitting required for installation of metal stair fabrications. Set Work accurately in location, alignment and elevation, level, true and free of rack, measured from established lines and levels. Furnish and install temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

C. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces of units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

D. Field Welding

Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made and for methods used in correcting welding.

E. Adjust railing prior to anchoring to ensure matching alignment at joints. Space posts as shown on the Contract Drawings or, if not shown, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

1. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
2. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
3. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to structural steel members, unless otherwise shown on the Contract Drawings.

F. Secure handrails to wall with wall brackets and end fittings. Bracket shall have clearance of not less than 1-1/2 inches from inside face of handrail and finished wall surface. Locate brackets as shown on the Contract Drawings or, if not shown, at spacing required for design loading. Secure wall brackets and wall return fittings to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
3. For hollow masonry anchorage use toggle bolts having square heads.
4. For stud partitions use lag bolts set into wood backing between studs. Coordinate with stud installation for accurate location of backing members.

G. Concrete Filled Treads and Platforms

Place and finish concrete fill for concrete treads and platforms, if any, to comply with Division 3 Section on concrete. Install abrasive nosings with anchors fully embedded in concrete.

H. Cast Treads and Nosings

1. Install cast treads and nosings with manufacturer's recommended anchorage system. Apply bituminous coating to concealed bottoms, sides and edges of cast-iron units set into concrete.
2. Nosings shall be centered and terminate not more than 3 inches from ends of treads for poured concrete stairs; nosings shall be full length of tread, less 1/8 inch clearance, on concrete filled steel pan stair treads, unless otherwise shown on the Contract Drawings.

3.03 ADJUSTING

A. Touch-Up Painting

1. Shop Painted Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces. Apply by brush or spray in a minimum dry film thickness of 2.0 mils.
2. Galvanized Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 05510

METAL STAIRS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05510A01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS: Shop Drawings. For fabrication and erection of metal stair fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Furnish templates for anchor and bolt installation under other Sections if required.

Samples

05510C01 Samples: Representative samples of materials, color, texture or design of finished products for treads and nosings, if any.

Product Data

05510D01 Product Data: Manufacturer's technical information, specifications, anchor details and installation instructions for products used in metal stair fabrications, including grout and paint products.

Calculations

05510H01 Design Calculations: Submit design calculations signed and sealed by a professional engineer licensed in the state in which Work is to be performed, showing compliance with Design and Performance Requirements loading criteria.

Qualifications

05510K01 E. Qualifications
1. Fabricator: Experience, in service performance and capability qualifications.
2. Professional Engineer: Include experience qualifications, if design calculations are required.
3. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

DIVISION 5

SECTION 05523

STEEL PIPE AND TUBE RAILINGS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for steel pipe and tube handrails and railings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Institute of Steel Construction, Inc. (AISC)
AISC 335	Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design with Commentary.
	American Society for Testing and Materials (ASTM)
ASTM A 36	Specification for Carbon Structural Steel.
ASTM A 47	Specification for Ferritic Malleable Iron Castings.
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A 501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM B 633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
ASTM C 1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.
	The Society for Protective Coatings (SSPC)
SSPC-Paint 20	Paint Specification No. 20 – Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
SSPC-SP 1	Surface Preparation Specification No. 1 – Solvent Cleaning.

SSPC-SP 3	Surface Preparation Specification No. 3 – Power Tool Cleaning.
SSPC-SP 7	Surface Preparation Specification No. 7 – Brush-Off Blast Cleaning.
SSPC-SP 10	Surface Preparation Specification No. 10 – Near-White Blast Cleaning.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Structural Performance

1. Handrails and railings shall be capable of resisting structural loads required by the New York City Building Code or the New Jersey Uniform Construction Code, as applicable to where the Project is located.

2. When installed, handrail and railing assemblies shall be capable of withstanding required gravity loads and structural loads, applicable to the specific location or use, without exceeding the allowable design working stress of the materials involved, including anchors and connections.

3. Thermal Movements: Allow for thermal movements of handrails and railings resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

B. Corrosion Control: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

1.04 QUALITY ASSURANCE

A. Where required by Appendix "A", submit structural calculations for handrails and railings. Determine allowable design working stresses of handrail and railing materials based on AISC 335.

B. Engineer Qualifications

A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design of handrails and railings indicated for this Project in material, design and installation.

C. Welding Standards

Comply with applicable provisions of AWS D1.1 *Structural Welding Code – Steel.*

1. Each welder shall have satisfactorily passed AWS qualification tests for welding processes involved and shall be currently AWS certified.

D. Single Source Responsibility

Obtain each type of handrail and railing through one source from a single manufacturer.

E. Field Measurements

Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

Protect material from damage including, but not limited to, scratches, nicks, dents and gouges during delivery, storage, assembly and installation.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

Metal surfaces shall be free from pitting, seam marks, roller marks, stains, discolorations and other imperfections where exposed to view on finished units.

B. Steel and Iron

Furnish steel and iron in the form shown on the Contract Drawings complying with the following requirements:

1. Steel Pipe: ASTM A 53.
   a. Type and Weight Class: Type F or Type S, Grade A, Schedule 40 (standard weight), unless another grade and weight are required by structural loads.
   b. Finish: Black finish or hot-dip galvanized, as shown on the Contract Drawings.
2. Steel Tubing: Cold-formed, ASTM A 500; or hot-rolled, ASTM A 501; black finish or hot-dip galvanized, as shown on the Contract Drawings.
3. Steel Plates, Shapes and Bars: ASTM A 36.
4. Castings: Gray iron, ASTM A 48, Class 30 or malleable iron, ASTM A 47, grade as recommended by fabricator for use shown on the Contract Drawings.

C. Brackets, Flanges and Fittings

Cast or formed metal of same type of material and finish as supported handrails and railings, unless otherwise shown on the Contract Drawings.

D. Welding Electrodes and Filler Metal

Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength and compatibility in fabricated items.

E. Fasteners

1. Use zinc-plated fasteners complying with ASTM B 633, Class Fe/Zn 25 (Service Condition 4–very severe). Do not use metals that are corrosive or incompatible with materials joined. Furnish concealed fasteners for interconnection of handrail and railing components and for their attachment to other Work.

2. Fasteners for Anchoring Handrails and Railings to Other Construction: Type, grade and class required to produce connections suitable for anchoring handrails and railings to other types of construction shown on the Contract Drawings and capable of withstanding design loads.

F. Anchors and Inserts

Type, size and material recommended by the railing manufacturer for type of loading and installation condition shown on Contract Drawings. Use stainless steel or hot-dip galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts as required, to be set into concrete or masonry.

G. Paint

1. Shop Primer for Ferrous Metal

Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Contract Drawings. Comply with applicable requirements of Division 9 Section on painting.

2. Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

H. Nonmetallic Grout

Pre-mixed, factory-packaged, nonshrink, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Furnish grout of grade specifically recommended by the manufacturer for interior or exterior applications.

I. Erosion Resistant Anchoring Cement

Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at the construction site to create pourable anchoring, patching and grouting compound. Formulation shall be resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and shall be recommended by manufacturer for exterior use.

2.02 FABRICATION

A. General

Fabricate handrails and railings to dimensions and details shown on the Contract Drawings. Furnish handrail and railing members in sizes and profiles shown on Contract Drawings, with supporting posts and brackets of size and spacing shown, but not less than required to support the design loadings required by 1.03 A.

1. Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark units for reassembly and coordinated installation.
2. Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges to a radius of approximately 1/32 inch. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
3. Cut, reinforce, drill and tap components to receive anchorage, finish hardware and similar items.
4. Close exposed ends of handrail and railing members with prefabricated end fittings.
5. Fabricate wall returns at ends of wall-mounted handrails. Close ends of returns. Furnish railing extensions at bottom and top of stairs as shown on the Contract Drawings.
6. Form bends by using prefabricated elbow fittings and radius bends, as applicable, of radii shown on the Contract Drawings, except where configuration shown requires bending of railing members.
7. Fabricate connections that will be exposed to weather in a manner to exclude water. Where water may accumulate, provide weepholes.

B. Welded Connections

Fabricate handrails and railings with welded connections, unless otherwise shown on the Contract Drawings. Cope components at perpendicular and skew connections to provide close fit or use fittings designed for this purpose. Weld connections continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blend so no roughness shows after finishing and so welded surface matches contours of adjoining surfaces.

C. Nonwelded Connections

Where railings are shown on the Contract Drawings to be adhesively or mechanically attached:

1. Fabricate handrails and railings to accommodate interconnection of members using railing manufacturer's standard concealed mechanical fasteners and fittings.

2. Assemble members and fittings to produce flush, smooth and rigid hairline joints.

3. Splice joints for field connection shall use epoxy structural adhesive where such procedure represents manufacturer's standard splicing method.

D. Toe Boards

Incorporate toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details shown on the Contract Drawings or, if not shown, fabricate toe boards 4 inches high. Use manufacturer's standard toe board material.

E. Brackets, Flanges, Fittings and Anchors

1. Use manufacturer's standard wall brackets, flanges, miscellaneous fittings and anchors for interconnection of handrail and railing members to other Work. Furnish inserts and other anchorage devices as shown on the Contract Drawings and as required to provide support. Coordinate anchorage types with supporting structure.

2. For railing posts set in concrete, furnish minimum 6 inch long galvanized steel sleeves, matching shape and configuration of railing posts and with outside dimensions not less than 1/2 inch greater than outside dimensions of post. Weld galvanized steel plate closures to bottoms of sleeves. Plate closures shall be 1 inch greater in length and width than outside dimensions of sleeves.

   a. Touch-up galvanized surfaces damaged by welding or abrasion by applying galvanizing repair paint to comply with ASTM A 780.

F. Galvanizing

1. Hot-dip galvanize railings shown on the Contract Drawings to be galvanized. Comply with applicable standards:

   a. Iron and steel products made from rolled, pressed and forged steel shapes, castings, plates, bars and strips: ASTM A 123.

   b. Iron and steel hardware: ASTM A 153.

2. Furnish galvanized fittings, brackets, fasteners, sleeves and other ferrous components for use with galvanized handrails and railings.

3. Fill vent and drain holes that will be exposed in finished Work, except those intended to remain as weep holes, by plugging with zinc and filing off smooth.

2.03 SHOP PAINTING

A. Galvanized Steel

Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux and other foreign matter and treat with zinc phosphate process. Apply primer within 12 hours of galvanizing or, if this can not be achieved, submit to the Engineer for approval, additional surface preparation measures to be performed, including but not limited to SSPC-SP 7.

B. Uncoated Steel

Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed handrails and railings:

1. Exteriors (SSPC Zone 1B): SSPC-SP 10.
2. Interiors (SSPC Zone 1A): SSPC-SP 1 and SSPC-SP 3.

C. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise shown on Contract Drawings. Comply with requirements in SSPC-PA 1 for shop painting. Primer is not required on surfaces to be embedded in concrete or masonry.

D. Apply additional paint coats as specified in Division 9 Section on painting.

E. Stripe paint edges, corners, crevices, bolts and welds.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as sleeves, inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction specified in other Sections. Coordinate delivery of such items to the construction site in time for installation.

3.02 INSTALLATION

A. General

1. Fit exposed connections accurately together to form tight, hairline joints.
2. Perform cutting, drilling and fitting required for installation of handrails and railings. Set Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
3. Do not weld, cut or abrade surfaces of handrails and railing components which have been coated or finished after fabrication and are intended for field connection by mechanical means without further cutting or fitting.
4. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
5. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
6. Adjust handrails and railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval shown on the Contract Drawings or, if not shown, as required by design loadings.

B. Anchoring Posts

1. Anchor posts in concrete using steel sleeves preset and anchored into the concrete, unless other methods are shown on the Contract Drawings. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.

2. Leave anchorage joint exposed, unless otherwise shown on the Contract Drawings. Wipe off excess grout and leave 1/8 inch build-up, sloped away from post. For installation exposed to exterior or to flow of water, seal grout to comply with grout manufacturer's directions.

3. Anchor posts to metal surfaces with manufacturer's standard fittings designed for this purpose.

C. Railing Connections

1. Use fully welded joints for permanently connecting railing components, unless otherwise shown on the Contract Drawings. Comply with requirements in 2.02 B for welded connections whether welding is performed in the shop or in the field.

2. Where railings are shown on the Contract Drawings to be mechanically or adhesively attached, use mechanical or adhesive joints for permanently connecting railing components. Prevent damage to railing members and fittings while making connections. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

D. Expansion Joints

Install expansion joints at locations shown on the Contract Drawings, but not farther apart than required to accommodate thermal movement. Furnish slip-joint internal sleeve extending 2 inches beyond joint on either side. Fasten internal sleeve securely to one side and locate joint within 6 inches of post.

E. Anchoring Railing Ends

1. Anchor railing ends into concrete or masonry with manufacturer's standard fittings designed for this purpose.

2. Anchor railing ends to metal surfaces with manufacturer's standard fittings using concealed fasteners.

F. Attachment of Handrails to Walls

1. Secure handrails to walls with manufacturer's standard wall brackets and end fittings.

2. For concrete and solid masonry, use drilled-in expansion shields for concealed bolts.

3. For hollow masonry anchorage, use toggle bolts with square heads.

3.03 ADJUSTING

A. At the construction site, repair finishes of handrails and railings damaged as a result of the Contractor's operations or furnish and install new railings. Remove handrails and railings whose finish cannot be repaired at the construction site and either return them to the fabrication shop, restore the finishes and reinstall, or furnish and install new handrails and railings. All such remedial Work shall be performed to the satisfaction of the Engineer and at no cost to the Authority.

B. Touch-Up Painting

1. Shop Painted Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces. Apply by brush or spray in a minimum dry film thickness of 2.0 mils.

2. Galvanized Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A 780.

3.04 PROTECTION

Protect finishes of handrails and railings from damage during installation and other Work of the Contract by use of temporary protective coverings approved by the railing manufacturer. Remove protective covering when other Work of the Contract is completed or when directed by the Engineer.

END OF SECTION

SECTION 05523

STEEL PIPE AND TUBE RAILINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05523A01 Drawings for fabrication and erection of handrails and railings, showing sizes, shapes and layout of all railing components. Include plans, elevations and details of fittings, connections, and anchorages to other Work. Furnish templates for anchors and bolts to be installed under other Sections.

Samples

05523C01 Samples for each type of finish shown on the Contract Drawings. Prepare samples on metal of same gauge and alloy to be used in Work. Where normal color and texture variations are to be expected, samples shall show limits of such variations. Include 6-inch long samples of distinctly different railing members including handrails, toprails, posts, rail coverings, and any appurtenances thereto, if any. Include samples of fittings and brackets.

Product Data

05523D01 Manufacturer's product specifications and instructions for products and processes used in the fabrication, assembly and installation of handrails and railings, including finishes and grout.

Calculations

05523H01 Professional Engineer: Demonstrate capabilities and experience. Include list of completed projects with project names, addressees, names of architects and owners.

Qualifications

05523K01 Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

05523K02 Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

05523

DIVISION 5

SECTION 05530

GRATINGS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the following grating types and accessories, where shown on the Contract Drawings:

1. Metal bar gratings.
2. Expanded metal gratings.
3. Formed metal plank gratings.
4. Extruded aluminum plank gratings.
5. Metal frames and supports for gratings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Architectural Manufacturers Association (AAMA)
AAMA 611	Specification for Anodized Architectural Aluminum.
	American Society of Mechanical Engineers (ASME)
ASME B18.21.1	Lock Washers (Inch Series).
ASME B18.22.1	Plain Washers.
	American Society for Testing and Materials (ASTM)
ASTM A 36	Specification for Carbon Structural Steel.
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A 276	Specification for Stainless Steel Bars and Shapes.
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A 510	Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
ASTM A 563	Specification for Carbon and Alloy Steel Nuts.
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A 666	Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

ASTM A 1011	Specification for Sheet, Steel and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B 221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM B 316	Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods.
ASTM B 633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
ASTM D 1187	Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metals.
ASTM E 488	Test Method for Strength of Anchors in Concrete and Masonry Elements.
ASTM F 593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ASTM F 594	Specification for Stainless Steel Nuts.
ASTM F 1267	Specification for Metal, Expanded, Steel.
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.
AWS D1.2	Structural Welding Code – Aluminum.
AWS D1.3	Structural Welding Code – Sheet Steel.
AWS D1.6	Structural Welding Code – Stainless Steel.
	National Association of Architectural Metal Manufacturers (NAAMM)
NAAMM MBG 531	Metal Bar Grating Manual for Steel, Stainless Steel, and Aluminum Gratings and Stair Treads.
NAAMM MBG 532	Heavy-Duty Metal Bar Grating Manual for Structural Carbon Steel and Stainless Steel.
AMP 500-505	Metal Finishes Manual for Architectural and Metal Products.
	The Society for Protective Coatings (SSPC)
SSPC-Paint 12	Paint Specification No. 12 – Cold Applied Asphalt Mastic (Extra Thick Film).
SSPC-Paint 20	Paint Specification No. 20 – Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
SSPC-SP 3	Surface Preparation Specification No. 3 – Power Tool Cleaning.
SSPC-SP 6	Surface Preparation Specification No. 6 – Commercial Blast Cleaning.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Gratings shall be capable of resisting structural loads required by provisions of the New York City Building Code and the New Jersey Uniform Construction Code which would apply if the Authority were a private corporation. Gratings shall also comply with applicable portions of OSHA. If OSHA is more stringent, it shall apply.

B. Gratings shall be capable of withstanding required gravity loads and structural loads, applicable to the specific grating use, without exceeding the allowable design working stress of the materials involved, including anchors and connections.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A" of this Section, submit structural calculations for gratings, signed and sealed by a professional engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

B. Fabricator Qualifications

A firm experienced in producing gratings similar to those shown on the Contract Drawings for Work of this Contract, with a record of successful in-service performance and sufficient production capacity to produce required units.

C. Engineer Qualifications

A professional engineer who is legally qualified to practice in jurisdiction where construction site is located and who is experienced in providing engineering services required for applications shown on the Contract Drawings. Engineering services are defined as those performed for installations of gratings that are similar in material, design and extent to those shown on the Contract Drawings for Work of this Contract.

D. Metal Bar Grating Standards

Comply with requirements of applicable portions of NAAMM MBG 531 and NAAMM MBG 532.

E. Welding Standards

Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification. Qualify procedures and personnel according to the following as applicable:

1. AWS D1.1 Structural Welding Code – Steel.
2. AWS D1.2 Structural Welding Code – Aluminum.
3. AWS D1.3 Structural Welding Code – Sheet Steel.
4. AWS D1.6 Structural Welding Code – Stainless Steel.

F. Field Measurements

Where gratings are shown on the Contract Drawings to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, furnish and install products by one of the following:

1. Metal Bar Gratings

   Alabama Metal Industries Corp. (AMICO), Birmingham, AL
   All American Grating, Inc., Pittsburgh, PA
   Barnett/Bates Corp., Joliet, IL
   Fisher & Ludlow (Div. of Harris Steel Ltd.), Plymouth, MI
   IKG Borden, Paramus, NJ
   Ohio Gratings, Inc., Canton, OH
   Tru-Weld Grating, Inc., Wexford, PA

2. Expanded Metal Gratings

   Alabama Metal Industries Corp. (AMICO), Birmingham, AL
   All American Grating, Inc., Pittsburgh, PA
   Fisher & Ludlow (Div. of Harris Steel Ltd.), Plymouth, MI

3. Formed Metal Plank Gratings

   Alabama Metal Industries Corp. (AMICO), Birmingham, AL
   Fisher & Ludlow (Div. of Harris Steel Ltd.), Plymouth, MI
   GS Metals Corp., Pinckneyville, IL
   IKG Borden, Paramus, NJ
   Morton Manufacturing Co., Libertyville, IL
   Unistrut Corp., Wayne, MI

4. Extruded Aluminum Plank Gratings

   AMICO-Klemp Corp., Birmingham, AL
   IKG Borden, Paramus, NJ
   Ohio Gratings, Inc., Canton, OH

2.02 MATERIALS

A. Steel

1. Steel Plates, Shapes, and Bars: ASTM A 36.
2. Steel Wire Rod for Grating Crossbars: ASTM A 510.
3. Uncoated Steel Sheet: ASTM A 1011, Commercial Steel, Type B.
4. Galvanized Steel Sheet: ASTM A 653, structural quality, Grade 33, with G90 coating.
5. Expanded Metal, Carbon Steel: ASTM F 1267, Type Regular or Flattened as shown on the Contract Drawings, Class 1 (uncoated sheet per ASTM A 1011, CS Type B).
6. Expanded Metal, Galvanized: ASTM F 1267, Type Regular or Flattened as shown on the Contract Drawings, Class 2 (hot-dip zinc-coated), Grade A (1.5 oz. per sq. ft. minimum coating thickness).

B. Stainless Steel

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
2. Bars and Shapes: ASTM A 276, Type 304.
3. Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316.
4. Bars and Shapes: ASTM A 276, Type 316.
5. Expanded Metal: ASTM F 1267, Type Regular or Flattened as shown on the Contract Drawings, Class 3.
6. For stainless steel units fabricated by welding, if any, use low-carbon type stainless steel.

C. Aluminum

1. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
   a. For bearing bars of gratings and shapes: 6061-T6 or 6063-T6.
   b. For grating crossbars: 6061-T1.
2. Aluminum Sheet: ASTM B 209, alloy 5052-H32.

D. Fasteners

1. General: Type 304 or 316 stainless steel fasteners for exterior use and fasteners complying with ASTM B 633, Class Fe/Zn 8 (Service Condition 2–moderate) where built into exterior walls. Select fasteners for type, grade and class required for application shown on the Contract Drawings.
2. Fasteners for Stainless Steel Gratings: Type 304 or 316 stainless steel.
3. Fasteners for Aluminum Gratings: Type 304 or 316 stainless steel.
4. Bolts and Nuts: Regular hexagon-head bolts, carbon steel, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and flat washers where shown.
5. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
6. Plain Washers: Round, carbon steel, ASME B18.22.1.
7. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   a. Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 8.
   b. Exterior Locations: Stainless steel bolts complying with ASTM F 593, Alloy Group 1 or 2 and nuts complying with ASTM F 594.

E. Paint

1. Shop Primer for Steel

   Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Contract Drawings. Comply with applicable requirements of Division 9 Section on Painting.

2. Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

3. Bituminous Paint

Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

Form gratings from materials of type, size, thickness and shapes shown on the Contract Drawings, but not less than that needed to support design loading.

A. Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise shown on the Contract Drawings.

C. Fit exposed connections accurately together to form hairline joints.

D. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

E. Provide for anchorage of type shown on the Contract Drawings; coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames and supports rigidly in place and to support design loading.

F. Toe Plates, if any: Fabricate to fit grating units and weld to units in shop, unless otherwise shown on the Contract Drawings.

1. Height: Extend toe plates minimum of 4 inches above the top surface of the grating, unless otherwise shown on the Contract Drawings.

2.04 CONSTRUCTION FEATURES

A. Provide cutouts in grating sections for penetrations in sizes and at locations shown on the Contract Drawings. Cut openings neatly and accurately to size. Arrange cutouts to permit grating removal without disturbing items penetrating gratings where removable grating section is shown on the Contract Drawings.

B. Metal Bar Gratings

1. Fabricate bar grating by one of the following methods as shown on the Contract Drawings:

a. Welded (steel or stainless steel).

b. Press-Locked (steel, aluminum or stainless steel).

c. Swage-Locked (aluminum or stainless steel).

d. Riveted (steel, aluminum or stainless steel).

2. Fabricate gratings with cross bars and bearings bars in material, type, sizes and spacings shown on the Contract Drawings, but not less than that required to comply with structural performance requirements.

3. Edge-band openings in grating that interrupt 4 or more bearing bars with bars of the same size and material as bearing bars.

4. Fabricate removable grating sections, if any, with banding bars attached by welding to entire perimeter of each removable section. Include anchors and fasteners of type shown on the Contract Drawings or, if not shown, as recommended by manufacturer for attaching to supports.

5. Traffic Surface for Steel and Stainless Steel Bar Gratings

   Plain, serrated, knurled or an applied abrasive finish consisting of aluminum oxide (corundum) aggregate in an epoxy-resin adhesive, as shown on the Contract Drawings.

6. Traffic Surface for Aluminum Bar Gratings

   Plain, grooved or an applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, as shown on the Contract Drawings.

7. Finish

   a. Steel: Hot-dip galvanize exterior steel bar gratings after fabrication; shop prime paint interior steel bar gratings, unless otherwise shown on the Contract Drawings.

   b. Aluminum: Mill finish, as fabricated, unless otherwise shown on the Contract Drawings.

   c. Stainless Steel: Mill finish, as fabricated, unless otherwise shown on the Contract Drawings.

C. Expanded Metal Gratings

1. Furnish expanded metal gratings in material, finish, type, size, thickness and weight shown on the Contract Drawings or, if not shown, as recommended by manufacturer for applications shown and as needed to support design loads.

2. Edge-band openings with bars of thickness not less than overall grating thickness at contact points.

3. Where gratings are pierced by pipes, ducts and structural members, cut openings and weld a strap collar not less than 1/8 inch thick to the cut ends. Divide panels into sections only to the extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts and structural members.

D. Formed Metal Plank Gratings

1. Furnish formed metal plank gratings in type, size, thickness, material and finish shown on the Contract Drawings or, if not shown, as recommended by manufacturer for applications shown and as needed to support design loads.

2. Type: C-shaped channel rolled from heavy sheet metal, punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.

3. Material: As follows and as shown on the Contract Drawings:

   a. Steel: 0.1046 inch thick (12 gage), ASTM A 653, G90 pre-galvanized.

   b. Aluminum: 0.100 inch thick, mill finish, unless otherwise shown.

4. Edge-band openings with metal sheet or bars having a thickness not less than grating material.

5. Where gratings are pierced by pipes, ducts and structural members, cut openings and weld a minimum 1/8 inch thick strap collar to the cut ends. Divide panels into sections only to the extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts and structural members.

6. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   "Diamond-Grip", Alabama Metal Industries Corp. (AMICO), Birmingham, AL
   "Grip Span", Fisher & Ludlow (Div. of Harris Steel Ltd.), Plymouth, MI
   "Grip Strut", GS Metals Corp., Pinckneyville, IL
   "Deck Span", IKG Borden, Paramus, NJ
   "Grip-Trac", Morton Manufacturing Co., Libertyville, IL
   "United Interlock", Unistrut Corp., Wayne, MI

E. Extruded Aluminum Plank Gratings

1. Furnish extruded aluminum plank gratings in type, size and finish shown on the Contract Drawings or, if not shown, as recommended by manufacturer for applications shown and as needed to support design loads.

2. Type: Extruded aluminum planks approximately 6 inches wide with multiple flanges approximately 1.2 inches o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface shall have raised ribs to increase slip resistance.

3. Depth: 2 inches, unless otherwise shown on the Contract Drawings.

4. Perforations: Rectangular, 19/32 by 3 inches, with adjacent rows staggered, unless otherwise shown on the Contract Drawings.

5. Finish: Mill, as fabricated, unless otherwise shown.

F. Grating Frames and Supports

1. Steel Frames and Supports: Fabricate from steel shapes, plates and bars of same basic metal and finish as grating, unless otherwise shown. Fabricate of welded construction to sizes, shapes and profiles shown on the Contract Drawings and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill and tap units to receive anchorage, hardware and similar items.

2. Aluminum Frames: Fabricate frames for extruded aluminum gratings from extruded aluminum shapes of same basic material and finish as grating, to sizes, shapes and profiles shown on the Contract Drawings and as necessary to receive gratings. Miter and weld connections. Cut, drill and tap units to receive anchorage, hardware and similar items.

3. Equip units with integrally welded anchors for casting into concrete or building into masonry.

   a. Space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long, unless otherwise shown on the Contract Drawings.

4. Galvanize steel frames and supports in the following locations:

   a. Exterior.

   b. Interior, where shown on the Contract Drawings.

2.05 SHOP FINISHING

A. Galvanized Steel

For items indicated to be galvanized, apply zinc coating by the hot-dip process complying with ASTM A 123. Minimum coating weight shall be 1.8 oz. per sq. ft. of coated surface. Where gratings, frames and supports are shown to be painted after galvanizing, prime and finish paint in accordance with Division 9 Section on Painting.

B. Painted Uncoated Steel

1. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed items:

   a. Exteriors (SSPC Zone 1B): SSPC-SP 6.

   b. Interiors (SSPC Zone 1A): SSPC-SP 3.

2. Shop Priming: Apply shop primer to prepared, uncoated surfaces of gratings, frames and supports, except those to be embedded in concrete or masonry, unless otherwise shown on the Contract Drawings. Comply with SSPC-PA 1 for shop painting.

3. Finish Painting: Finish paint shop primed surfaces of gratings, frames and supports in accordance with Division 9 Section on Painting.

C. Finishes

1. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.

2. Finish aluminum and stainless steel gratings, frames and supports after assembly.

3. Aluminum Finish: Class I clear anodic; AA M12-C22-A41 (0.7 mil or thicker), complying with AAMA 611 for gratings, supports and frames where shown on the Contract Drawings.

4. Stainless Steel Finish: Mill, unless other finish is shown on the Contract Drawings.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate installation of anchorages for gratings, grating frames and supports. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to construction site in time for installation.

3.02 INSTALLATION

A. General

1. Fastening to In-Place Construction: Install anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts and other connectors.
2. Cutting, Fitting, and Placement: Perform cutting, drilling and fitting required for installing gratings. Set units accurately in location, alignment and elevation measured from established lines and levels and free from rack.
3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
4. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
5. Field attach toe plates which could not be factory welded by field welding, unless otherwise shown on the Contract Drawings.
6. Field Welding: Comply with the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. Do not weld, cut or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
7. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood or dissimilar metals with a heavy coat of bituminous paint.

B. Installing Metal Bar Gratings

1. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes shown on the Contract Drawings, including installation clearances, minimum bearing dimensions at supports and standard anchoring details.
2. Install gratings with cross bars on top side.
3. Do not notch bearing bars at supports to maintain elevation.

4. Attach removable units to supporting members with type and size of clips and fasteners shown on the Contract Drawings or, if not shown, as recommended by grating manufacturer for type of installation conditions shown.

5. Attach nonremovable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

C. Installing Expanded Metal Gratings

1. General: Comply with manufacturer's written instructions for installing gratings.

2. Place units with straight edge of bond up and with the long direction of diamond-shaped openings (LWD) parallel to direction of span.

3. Attach removable units to supporting members by bolting at 6 inch intervals.

4. Attach nonremovable units to supporting members by welding, unless otherwise shown on the Contract Drawings. Space welds at 6 inch intervals.

5. Attach aluminum units to steel supporting members by bolting at 6 inch intervals.

6. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with diamonds of adjacent sections.

D. Installing Metal Plank Gratings

1. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

2. Attach removable units to supporting members by bolting at every point of contact.

3. Attach nonremovable units to supporting members by welding, unless otherwise shown on the Contract Drawings. Comply with manufacturer's written instructions for size and spacing of welds.

4. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.03 ADJUSTING AND CLEANING

A. Touch-Up Painting

1. Shop Painted Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop painted surfaces. Apply by brush or spray in a minimum dry film thickness of 2.0 mils.

2. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas. Repair galvanizing to comply with ASTM A 780. Apply by brush or spray in a minimum dry film thickness of 3 mils.

END OF SECTION

SECTION 05530

GRATINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

05530A01 Shop Drawings: Show fabrication and installation details for gratings. Include plans, elevations, sections, and details of connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation, where required.

Product Data

05530D01 Formed-metal plank gratings.

05530D02 Extruded-aluminum plank gratings.

05530D03 Clips and anchorage devices for gratings.

05530D04 Paint products.

Certificates

05530E01 Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

05530E02 Welding Certificates: Copies of certificates for welding procedures and personnel.

Qualifications

05530K01 Qualification Data: For firms and persons specified in Article 1.04 "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

END OF APPENDIX "A"

DIVISION 5

SECTION 05532

ALUMINUM RIVETED BAR GRATINGS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for metal fabrications, including but not limited to aluminum extruded bars and shapes, plates and anchorage for aluminum riveted bar gratings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

American Society for Testing and Materials (ASTM)

ASTM B221	Aluminum Extruded Bars and Shapes

National Association of Architectural Metal Manufacturers

ANSI/NAAMM MBG-531-09	Metal Bar Grating Manual

1.03 QUALITY ASSURANCE

A. Manufacturer Qualification: A company specializing in the manufacture of metal bar gratings with not less than 10 years of documented experience.

B. Fabrication tolerances shall be in accordance with applicable provisions and recommendations of ANSI/NAAMM 531-09 Metal Bar Grating Manual.

1.04 PERFORMANCE REQUIREMENTS

Design the grating for the following design criteria:

Grating Products shall be designed and manufactured to meet the live load conditions of 100 lbs/ Sq Ft with a maximum deflection of ¼" for the clear spans shown on the drawings. The fastener system for grating to supporting members shall be designed to meet the upward wind load of 20 psf.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS - GENERAL

Contractor shall furnish, deliver, and install the aluminum grating panels, any miscellaneous metal forms (or other related forming materials) as shown in the contract drawings and in accordance with the manufacturers' recommendations.

Within 15 days after the contract is awarded, the Contractor shall notify the Engineer of the name, address, telephone number, and contact person of the steel grid fabricator of all deck panels to be manufactured, supplied, and installed.

Provide appropriate fasteners for type, grade, and class required for the approved anchorage system.

2.02 ALUMINUM RIVETED BAR GRATING

1. Model Specification for type 18-AR-7 Aluminum Riveted Bar Gratings as Manufactured by Ohio Gratings Inc. 5299 Southway St. SW, Canton, Ohio 44706, Tel. 800-321-9800 www.ohiogratings.com, or approved equal.
   a. Description: Aluminum Riveted Rectangular Bar Grating type 18-AR-7: Straight bearing bars and bent connecting bars joined at their contact points by hydraulically compressed rivets 7" on center.
      (1) Bearing Bar Spacing: 1-1/8" face to face.
      (2) Bearing Bar Depth: As specified in the contract drawing.
      (3) Bearing Bar Thickness: 3/16" to provide 1-1/8" space between bearing bars.
      (4) Top Surface of Bearing Bars: Slip Resistant
      (5) Top Surface of Connecting Bars: Serrated & raised 1/8"
   b. Materials: Bearing bars and banding shall be Aluminum Type 6063-T6 and Aluminum Cross Bars are Type 6063-T52 as per ASTM B221.

2.03 FABRICATION - GENERAL

A. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings. Band ends and cuts in grating with bars of same size and material as bearing bars.

B. Fabrication Tolerances shall be in accordance with ANSI/NAAMM MBG 531-09 Metal Bar Grating Manual.

C. Finish: Gratings shall be A-41 Clear Anodized.

PART 3. EXECUTION

3.01 PREPARATION

A. Field Verification: Take field measurements prior to preparation of final shop drawings and fabrication where required to ensure proper fitting of the work.

B. Installation:

1. Prior to grating installation, Contractor shall inspect supports for correct alignment and conditions for proper attachment and support of the gratings. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the architect or owner's agent prior to placement.
2. Install grating in accordance with approved shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-531-09 Metal Bar Grating Manual.
3. Protection of Aluminum from Dissimilar Materials:

   Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by Applying A-41 anodized finish with neoprene pad.

C. Grating Attachment: Use approved attachment system and fasteners to secure grating to supporting members as shown on plans.

END OF SECTION

SECTION 05532

ALUMINUM RIVETED BAR GRATINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - General Provisions.

A. Shop drawings.

The Contractor shall submit shop drawings for the fabrication and erection of all gratings for approval, based on construction plans, include plans, elevations, and details of sections and connections as required. Show type and location of all fasteners.

B. Samples.

Samples of Grating and Anchorage system shall be submitted for approval.

C. Product Data.

The Contractor shall submit the manufacturer's catalog pages including load tables, specifications, connection details, anchor details and standard installation details.

D. Certificates.

Submit following certificates:

1. Professional Engineer: Include experience qualifications.
2. Fabricator: Experience, in-service performance and capability qualifications.
3. Welder: Evidence of current AWS certification.

E. Design Calculations.

Submit design calculations signed and sealed by a professional engineer licensed in the state in which work is to be performed, showing compliance with Design and Performance Requirement's loading criteria.

END OF APPENDIX "A"

DIVISION 5

SECTION 05700

ORNAMENTAL METALWORK

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies finished ornamental metalwork not specified in Division 5 Section on sheet metal fabrications, including but not limited to extrusions, castings, moldings and rolled shapes.

B. Items specified in this Section include, but are not limited to the following, where shown on the Contract Drawings:

1. Ornamental railings, excluding pipe railings specified in other Division 5 Sections.
2. Ornamental diffusers, grilles and frames.
3. Ornamental castings.
4. Extruded reveals.
5. Extruded wall and column cladding.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	<u>The Aluminum Association, Inc. (AA)</u>
	Aluminum Design Manual – Specifications for Aluminum Structures.
	<u>American Architectural Manufacturers Association (AAMA)</u>
AAMA 611	Specification for Anodized Architectural Aluminum.
AAMA 2603	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A36	Specification for Carbon Structural Steel.
ASTM A47	Specification for Ferritic Malleable Iron Castings.
ASTM A48	Specification for Gray Iron Castings.
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A276	Specification for Stainless Steel Bars and Shapes.

ASTM A312	Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
ASTM A492	Specification for Stainless Steel Rope Wire.
ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A554	Specification for Welded Stainless Steel Mechanical Tubing.
ASTM A666	Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
ASTM A743	Specification for Castings, Iron Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
ASTM A780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM B26	Specification for Aluminum-Alloy Sand Castings.
ASTM B36	Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM B43	Specification for Seamless Red Brass Pipe, Standard Sizes.
ASTM B62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B108	Specification for Aluminum-Alloy Permanent Mold Castings.
ASTM B135	Specification for Seamless Brass Tube.
ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B211	Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
ASTM B221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM B247	Specification for Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
ASTM B249	Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings.
ASTM B429	Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
ASTM B455	Specification for Copper-Zinc-Lead Alloy (Leaded Brass) Extruded Shapes.
ASTM B483	Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
ASTM B584	Specification for Copper Alloy Sand Castings for General Applications.
ASTM C1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
ASTM D1187	Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

American Welding Society Inc. (AWS)

AWS D1.1	Structural Welding Code – Steel.
AWS D1.2	Structural Welding Code – Aluminum.
AWS D1.6	Structural Welding Code – Stainless Steel.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual for Architectural and Metal Products.

The Society for Protective Coatings (SSPC)

SSPC-Paint 12	Paint Specification No. 12 – Cold-Applied Asphalt Mastic (Extra Thick Film).
SSPC-Paint 20	Paint Specification No. 20 – Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).
SSPC-SP 6	Surface Preparation Specification No. 6 – Commercial Blast Cleaning.
SSPC-SP 7	Surface Preparation Specification No. 7 – Brush-Off Blast Cleaning.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Structural Performance

1. Items requiring design computations by the Contract Drawings shall be designed to withstand all structural loads, as required by building codes which would apply if the Authority were a private corporation.

2. Handrails and railings shall be capable of resisting structural loads required by the New York City Building Code or the New Jersey Uniform Construction Code, as applicable to where the Project is located.

3. When installed, handrail and railing assemblies shall be capable of withstanding required gravity loads and structural loads, applicable to the specific location or use, without exceeding the allowable design working stress of the materials involved, including anchors and connections.

4. Thermal Movements: Allow for thermal movements of handrails and railings resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

B. Corrosion Control

Prevent galvanic action and other forms of corrosion by isolating metals and other materials from other incompatible materials.

1.04 QUALITY ASSURANCE

A. Where required by the Engineer or by Appendix "A", submit structural calculations for ornamental handrails and railings.

B. Engineer Qualifications

A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installation of handrails and railings that are similar to those indicated for this Project in material, design and extent.

C. Fabricator Qualifications

Firm experienced in successfully producing ornamental metalwork similar to that indicated for Work of this Contract and with sufficient production capacity to produce required units without delaying the Work.

D. Organic Coating Applicator Qualifications

Firm experienced in successfully applying organic coatings of type indicated to aluminum extrusions and equipped with the following:

1. A multistage aluminum cleaning and pretreatment system capable of complying with test requirements of AAMA standard referenced for type of coating indicated.
2. Spray equipment required to apply a uniform coating.
3. Baking facilities required to cure coating to achieve maximum hardness, mar-resistance and exterior durability.

E. Anodic Finish Applicator Qualifications

Firm experienced in successfully applying anodic finishes of type indicated, employing competent control personnel to conduct continuing, effective quality control program to ensure compliance with requirements.

F. Welding Standards

Comply with applicable provisions of AWS D1.1 *Structural Welding Code – Steel*, AWS D1.2 *Structural Welding Code – Aluminum*, and AWS D1.6 *Structural Welding Code – Stainless Steel*.

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification.
2. All welders shall be licensed in the state in which the Work is to be performed.

G. Field Measurements

Where ornamental metalwork is shown on the Contract Drawings to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication and indicate recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

Protect materials from scratches, nicks, dents and gouges during delivery, storage, assembly and installation. Remove damaged materials from the construction site and replace them at no cost to the Authority.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers

Subject to compliance with requirements of this Section, manufacturers offering products and assemblies that may be incorporated in the Work include, but are not limited to, the following:

1. Ornamental Railings

   Milgo/Bufkin, Brooklyn, NY
   Moli Metal Inc., St. Leonard, QU
   Soheil Mosun, Toronto, ON
   Rippel Architectural Metals, Inc., Chicago, IL
   Zephyr Metals, Inc., Tulsa, OK

2. Ornamental Diffusers, Grilles and Frames

   Architectural Grille, Div. of Giumenta Corp., Brooklyn, NY
   Reggio Register Co., Inc., Ayer, MA
   Register & Grille Manufacturing Co., Inc., Brooklyn, NY

3. Ornamental Castings

   Lawler Machine & Foundry Co. Inc., Birmingham, AL
   Milgo/Bufkin, Brooklyn, NY
   Moli Metal Inc., St. Leonard, QU
   Soheil Mosun, Toronto, ON
   Tennessee Fabricating Co., Memphis, TN

4. Stainless Steel Wire Rope and Fittings

   Décor Cable, Chicago, IL
   Feeney Wire Rope & Rigging, Oakland, CA
   Seco South Inc., Largo, FL

5. Extruded Wall and Column Cladding

   Custom Enclosures, Inc., Wheeling, IL
   Hi-Tech Metals, Inc., Maspeth, NY
   MM Systems Corp., Pendergrass, GA
   Milgo/Bufkin, Brooklyn, NY
   Moli Metal Inc., St. Leonard, QU
   Soheil Mosun, Toronto, ON

2.02 MATERIALS

A. General

Select material which has a high degree of surface flatness, smoothness and freedom from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces that exhibit pitting, seam marks, roller marks, "oil-canning", stains, discolorations or other imperfections on finished units will not be acceptable.

B. Aluminum

Comply with the following standards for the forms and types of aluminum for the required Work.

1. Furnish alloy and temper as shown on the Contract Drawings, except as otherwise recommended by the aluminum producer or finisher.
2. Extrusions: Alloy and temper shall be as recommended by aluminum producer or finisher with not less than the strength and durability properties specified in ASTM B221 for 6063-T5.
3. Extruded Pipe and Tubes: ASTM B429,6063-T6.
4. Plate and Sheet: Alloy and temper as recommended by aluminum producer or finisher for type of use and finish required, and with not less than strength and durability properties specified in ASTM B209 for 6061-T6.
5. Bars, Rods and Wire: ASTM B211.
6. Drawn Seamless Tube: ASTM B483.
7. Die and Hand Forgings: ASTM B247,6061-T6.
8. Castings: ASTM B26 or ASTM B108, alloy 214 for natural anodized finish and alloy 43 for color anodized or baked enamel finish, except as otherwise recommended by aluminum producer or finisher.

C. Stainless Steel

Grade and type designated below for each form required:

1. Tubing: ASTM A554, Grade MT, 304, for interior use; Grade MT, 316, for exterior use.
2. Pipe: ASTM A312, Grade TP 304, for interior use; Grade TP 316, for exterior use.
3. Castings: ASTM A743, Type 304, Grade CF8 or CF20, for interior use; Type 316, Grade CF8M, for exterior use.
4. Plate: ASTM A666, Type 304 for interior use; Type 316 for exterior use.
5. Bar Stock: ASTM A276, Type 304 for interior use; Type 316 for exterior use.
6. Wire Rope: Specifically fabricated 1-by-19 cable that is drawn through a die after laying to produce a smooth outer surface, made from wire conforming to ASTM A492, Type 316.

D. Steel and Iron

Furnish steel and iron in the form indicated complying with the following requirements:

1. Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501.
2. Steel Plate, Shapes, and Bars: ASTM A36.
3. Castings: Gray iron, ASTM A48, Class 30 or malleable iron, ASTM A47, grade as recommended by fabricator for use shown on the Contract Drawings.

E. Copper Alloys, Brass

Furnish copper alloy of type and form shown on the Contract Drawings to comply with the following requirements:

1. Extruded Shapes: ASTM B249, alloy UNS No. C36000 (free-cutting brass).
2. Plate and Bars: ASTM B36, alloy UNS No. C26000 (cartridge brass, 70 percent copper).
3. Seamless Tubes: ASTM B135, alloy UNS No. C26000 (cartridge brass, 70 percent copper).
4. Sand Castings: ASTM B584, alloy UNS No. C85200 (high copper yellow brass).

F. Copper Alloys, Bronze

Furnish copper alloy of type and form shown on the Contract Drawings to comply with the following requirements:

1. Extruded Shapes: ASTM B455, alloy UNS No. C38500 (architectural bronze).
2. Plate and Bars: ASTM B36, alloy UNS No. C28000 (Muntz metal, 60 percent copper).
3. Seamless Pipe: ASTM B43, alloy UNS No. C23000 (red brass, 85 percent copper).
4. Seamless Tubes: ASTM B135, alloy UNS No. C23000 (red brass, 85 percent copper).
5. Composition Bronze Castings: ASTM B62, alloy UNS No. C83600 (85-5-5-5 or composition bronze).

G. Welding Electrodes and Filler Metal

Type and alloy of filler metal and electrodes shall be as recommended by producer of the metal to be welded, complying with applicable AWS specifications and as required for color match, strength and compatibility between dissimilar materials in the fabricated items.

H. Fasteners

Finish of fastener metal and alloy shall match color and texture of the metal being fastened. Use concealed fasteners for interconnection of ornamental metalwork components and for their attachment to other Work, except where otherwise shown on the Contract Drawings. Use Phillips flat-head screws, countersunk, for exposed fasteners, if any.

I. Anchors and Inserts

Furnish inserts to be set in concrete or masonry and furnish other anchoring devices as required for the installation of ornamental metal items. Use toothed steel or lead shield expansion bolt devices or drilled-in-place anchors. Furnish hot-dip galvanized anchors and inserts for exterior installations. Exposed surfaces of units shall match texture and finish of the metal item anchored.

J. Wire Rope Fittings

Connectors of types indicated, fabricated from stainless steel and with capability to sustain, without failure, a load equal to the minimum breaking strength of the wire rope with which they are used.

K. Paint

1. Shop Primer for Ferrous Metal

Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Contract Drawings. Comply with applicable requirements of Division 9 Section on Painting.

2. Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

3. Bituminous Paint

Cold-applied mastic painting system complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D1187.

L. Protective Lacquer

Clear, air-drying, non-yellowing acrylic lacquer for protection of finished copper alloy surfaces.

M. Nonmetallic Grout

Premixed, factory-packaged, nonshrink, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Furnish grout specifically recommended by manufacturer for interior and exterior applications.

2.03 FABRICATION

A. General

Form metalwork to the required shapes, sizes and finishes, with true curves, lines and angles. Furnish necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners wherever possible. Finish exposed surfaces to smooth, sharp, well-defined lines and arrises.

1. Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark units for reassembly and coordinated installation.

2. Comply with AWS for recommended practices in shop welding and brazing. Welds and brazes behind finished surfaces shall not distort or discolor exposed side. Clean exposed welded joints of all welding flux and dress all exposed and contact surfaces.

3. Castings shall be sound and free of warp or defects that impair strength and appearance. Mill joints to a close fit and finish exposed surfaces to smooth, sharp, well-defined lines and arrises.

4. Fabricate wire rope assemblies in the shop to field measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so that maximum amount is available for tensioning wire ropes. Tag wire rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

5. Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

6. Use connections that maintain structural value of joined pieces.

7. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

8. Provide weepholes where water may accumulate.

B. Fabricating Handrails and Railings

1. Nonwelded Connections: Fabricate railing systems and handrails to interconnect members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints. Fabricate splice joints for field connection using an epoxy structural adhesive where this represents fabricator's standard splicing method.

2. Welded Connections: Fabricate handrails and railing systems of materials indicated to interconnect members by welding where shown on the Contract Drawings. Use welding method that is appropriate for metal and finish indicated and that develops strength required to comply with structural performance criteria. Finish exposed welds and surfaces smooth, flush and blended to match adjoining surfaces.

3. Brackets, Flanges, Fittings and Anchors: Furnish wall brackets, flanges and miscellaneous fittings required to interconnect handrail and railing members to other Work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry Work. Fabricate anchorage devices that are capable of withstanding load imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

4. Form changes in direction of railing members by radius bends of radius shown on the Contract Drawings.

5. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required. Maintain profile of member throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of handrail and railing components.

6. Close exposed ends of handrail and railing members with manufacturer's standard prefabricated end fittings.

7. Furnish wall returns at ends of wall-mounted handrails, unless otherwise shown on the Contract Drawings. Close ends of returns, unless clearance between end of railings and wall is 1/4 inch or less. Furnish railing extensions at bottom and top of stairs as shown on the Contract Drawings.

8. For handrails and railing systems that are exposed to exterior or to moisture from condensation or other sources, provide weepholes or another means to drain water entrapped in hollow sections of railing members.

C. Fabricating Diffusers, Grilles and Frames

1. Fabricate ornamental grilles from metal components of thickness, size and shape shown on the Contract Drawings. Form perforations, when required, by punching, cutting or drilling to produce openings of sizes and shapes indicated. Roll, press and grind perforated metal to flatten and remove burrs and deformations.

   a. The required perforation patterns shown on the Contract Drawings, if any, are based on the products of one manufacturer. Similar patterns produced by other manufacturers may be considered, subject to Engineer's approval.

2. Where grilles without frames are shown on the Contract Drawings, drill and countersink grilles for countersunk mounting screws. Furnish units with countersunk screws of metal to match grilles.

3. Where grilles with frames are shown on the Contract Drawings, fabricate grille frames from extruded metal of profiles and to sizes and shapes indicated. Miter frame members at corners and connect with concealed splice plates welded or brazed to the back of frames.

4. Drill and countersink frames for countersunk mounting screws. Furnish units with countersunk screws of metal to match frames.

D. Fabricating Castings

Fabricate cast metal units to design from cast metal type shown on the Contract Drawings. Drill and tap castings for threaded mounting studs.

E. Fabricating Metal Reveals

Cut reveals from metal channels of material and sizes shown on the Contract Drawings. Drill and countersink for mounting screws.

F. Fabricating Extruded Wall and Column Cladding

Fabricate wall and column cladding from extrusions of dimensions shown on the Contract Drawings. Incorporate reveals, trim and concealed anchorages for attachment to columns or adjacent construction as shown on the Contract Drawings.

2.04 SHOP FINISHING

A. General

1. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations relative to application and designations of aluminum, stainless steel and copper alloy finishes, except as otherwise shown on the Contract Drawings.

2. Protect mechanical finishes on exposed surfaces from damage by application of strippable temporary protective covering prior to shipment.

B. Aluminum Finishes

Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes, listed in NAAMM's *Metal Finishes Manual for Architectural and Metal Products*.

1. Anodized Finish

a. Class I Clear Anodic: AA M12-C22-A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear film 0.7 mil or thicker), complying with AAMA 611.

b. Class I Color Anodic: AA M12-C22-A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, film 0.7 mil or thicker with integral color or elctrolytically deposited color), complying with AAMA 611.

c. Color: As shown on the Contract Drawings or, if not shown, as selected by Engineer from full range of industry colors and color density range.

2. Baked Enamel Finish

AA C21-C42-R1x (Chemical Finish: cleaned with inhibitive chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's specification for cleaning, conversion coating and painting.

a. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 1.5 mils, medium gloss.

b. Color: As selected by Engineer from manufacturer's full range of colors.

3. High Performance Organic Coating

AA C12-C42-R1x (Chemical Finish: cleaned with inhibitive chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Arrange for a licensed applicator to prepare, pretreat and apply coating to exposed metal surfaces in accordance with coating and resin manufacturer's instructions.

a. Fluoropolymer 3-Coat System: 3-coat thermocured system consisting of specially formulated inhibitive primer, 0.2 mil minimum dry film thickness; fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight, in a dry film thickness of 1.0 mil minimum; and a clear PVDF based seal coat. Comply with AAMA 2605.

b. Color and Gloss: As selected by Engineer form manufacturer's full range of choices for color and gloss.

c. Manufacturer shall furnish a written warranty for the Authority's benefit covering failure of the fluoropolymer coating system for a period of 20 years after the date of Final Completion.

C. Stainless Steel Finishes

Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating stainless steel finishes, listed in NAAMM's *Metal Finishes Manual for Architectural and Metal Products*.

1. Remove or blend tool and die marks and stretch lines into finish.

2. Grind and polish surfaces to produce uniform, directional, textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

3. Furnish one or more of the following finishes, where shown on the Contract Drawings:

a. Bright, Directional Polish: AISI No. 4 finish.

b. Satin, Directional Polish: AISI No. 6 finish.

c. Satin, Reflective, Directional Polish: AISI No. 7 finish.

d. Mirror-Like Reflective, Nondirectional Polish: AISI No. 8 finish.

e. Nondirectional Finish: #BJNDF-60 finish, as manufactured by Milgo Industrial, Inc., Brooklyn, NY, or approved equal.

4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

D. Iron and Steel Finishes

1. Galvanizing: Hot-dip galvanize items shown on the Contract Drawings to be galvanized to comply with applicable standard listed below:

a. Iron and steel products made from rolled, pressed and forged steel shapes, castings, plates, bars and strips: ASTM A123.

b. Iron and steel hardware: ASTM A153.

2. Fill vent drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

3. Preparation for Shop Priming: After galvanizing, thoroughly clean ornamental metalwork of grease, dirt, oil, flux and other foreign matter and treat with metallic phosphate process.

4. Uncoated Steel

   Preparation for Shop Priming: *Prepare uncoated ferrous metal surfaces to comply* with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed ornamental metalwork:

   a. Exteriors (SSPC Zone 1B): SSPC-SP 6.

   b. Interiors (SSPC Zone 1A): SSPC-SP 7.

5. Factory Primed Finish: Apply air-dried primer immediately following cleaning and pretreatment, to provide a minimum dry film thickness of 2.0 mils per applied coat to surfaces that will be exposed after assembly and installation, and to concealed, nongalvanized surfaces.

6. Apply an air-dried primer in shop and successive coats in field, as specified in Division 9 Section on Painting.

E. Copper Alloy Finishes (Brass and Bronze)

Finish designations prefixed by "CDA" conform to the system established by the Copper Development Association for designating copper alloy finishes, listed in NAAMM's *Metal Finishes Manual for Architectural and Metal Products*.

1. Natural Satin Finish, Lacquered:. CDA M31-M34-06x (Mechanical Finish: directional textured; hand-rubbed; clear organic coating: Clear air-drying, acrylic lacquer specially developed for coating copper alloy products, applied by air spray in 2 coats per manufacturer's directions, with interim drying, to a total thickness of 1.0 mil. Subject to compliance with requirements, furnish "Incralac" developed by International Copper Research Association (INCRA).

2. Statuary (Oxidized) Conversion Coating over Satin Finish: CDA M32-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide).

   a. Color: As shown on the Contract Drawings or, if not shown, as selected by the Engineer.

3. Patina (Verde Antique) Conversion Coating: CDA M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfide).

   a. Color: As shown on the Contract Drawings or, if not shown, as selected by the Engineer.

PART 3. EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installation of items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the construction site.

B. Inspect ornamental metal items before installation to verify that they are free from scratches, nicks, dents and other defects. Repair or replace defective items.

3.02 INSTALLATION

A. General

Install anchorage devices and fasteners where necessary for securing ornamental metal items to existing construction in-place at the construction site, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

1. Perform all cutting, drilling and fitting required for the installation of the ornamental metal items. Set Work accurately in location, alignment and elevation, plumb, level and true, measured from established lines and levels, and in proper alignment and relationship to adjacent construction. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.

2. Form tight joints with exposed connections accurately fitted with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding and grinding are required for proper shop fitting and jointing of Work, restore finishes to eliminate any evidence of such corrective Work.

3. Do not cut or abrade finishes of ornamental metalwork unless such finishes can be completely restored at the construction site. Any item whose finish cannot be cut or abraded and subsequently refinished solely at the construction site, shall either be removed to a location where required alterations can be performed and refinishing accomplished or replaced with a new item, at the option of the Contractor and at no cost to the Authority.

4. Install concealed gaskets, joint fillers, insulation and flashings, if any, as the Work progresses to make the Work weather-tight, soundproof or lightproof as required by the applications shown on the Contract Drawings.

5. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with concrete, masonry, wood or dissimilar metals, in exterior Work and Work to be built into exterior and below grade walls and decks, with a heavy coat of bituminous paint. Do not extend coating onto exposed surfaces.

B. Installing Handrails and Railings

1. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

2. Anchoring Posts: Anchor posts in concrete using sleeves preset and cast into concrete, unless other methods are shown on the Contract Drawings. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.

   a. Anchor posts to metal surfaces with fittings designed for this purpose.

3. Railing Connections

   a. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components, unless otherwise shown on the Contract Drawings. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes for exposed locking screws using plastic filler, cement colored to match finish of handrails and railing systems.

   b. Welded Connections: Where welding is shown on the Contract Drawings, use fully welded joints for permanently connecting railing components. Cope or butt components to provide 100 percent contact or use fittings designed for this purpose.

4. Anchor railing ends into concrete or masonry with fittings designed for this purpose.

5. Anchor railing ends to metal surfaces with fittings using concealed fasteners.

6. Anchor railing ends to metal surfaces by welding.

7. Expansion Joints: Install expansion joints at locations shown on the Contract Drawings or, if not shown, at intervals not to exceed 40 feet. Furnish slip-joint internal sleeve extending 2 inches beyond joint on either side. Fasten internal sleeve securely to one side and locate joint within 6 inches of post.

C. Installing Ornamental Mechanical Grilles

Mount ornamental mechanical grilles at heights and in positions indicated, adjusting ductwork as required to be centered on grilles. Secure to wall framing with wood screws. On marble, brick and other solid surfaces, secure with wood screws in plastic sleeves.

3.03 ADJUSTING AND CLEANING

A. Cleaning

1. Wash aluminum and stainless steel thoroughly with clean water and soap; rinse thoroughly with clean water and wipe dry.

2. Clean copper alloy per fabricator's written recommendations.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections and abraded areas of shop paint are specified in Division 9 Section on painting.

C. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

3.04 PROTECTION

A. Retain protective coverings intact. Restore protective coverings that have been damaged during shipment or installation of the Work. Remove protective coverings only when there is no possibility of damage from other Work to be performed at the same location.

1. Remove protective coverings simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.

2. Remove protective coverings from conversion coated copper alloy units as soon as possible after installation.

END OF SECTION

SECTION 05700

ORNAMENTAL METALWORK

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's, fabricator's and finisher's specifications, installation and cleaning instructions for products used in ornamental metalwork, including finishing materials and methods.

B. Shop Drawings

Include plans, elevations and detail sections. Indicate materials, gage, methods, types of joinery, fasteners, anchorages and accessory items; specify finishes. Furnish setting diagrams and templates for anchorages, sleeves and bolts installed by other trades.

C. Samples

1. For each type of metal finish shown on the Contract Drawings, prepare samples of metal of same alloy and thickness to be used for the Work. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples described below, showing the limits of such variations.

   a. Include 6 inch long samples of linear shapes.

   b. Include 6 inch square samples of plates.

   c. Include full-size samples of castings and forgings.

2. Patterns, models or plaster castings made for each custom design of casting shown on the Contract Drawings, if any.

D. Design Calculations

Submit design computations signed and sealed by a Professional Engineer licensed in the State where the Work is performed.

E. Qualifications

1. Professional Engineer: Demonstrate capabilities and experience. Include list of completed projects with project names, addressees, names of architects and owners (if design calculations are required).

2. Fabricator: Demonstrate capabilities and experience.

3. Finisher: Demonstrate capabilities and experience.

4. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

DIVISION 5

SECTION 05830

MODULAR EXPANSION JOINTS

PART 1. GENERAL

1.01 SUMMARY

A. This Section and its appendices specify requirements for furnishing and installing modular, multiple seal expansion joint system in accordance with the geometry and movements shown and specified in the Contract Drawings.

1.02 SYSTEM DESCRIPTION

A. Modular expansion joint system consists of multiple strip seals supported by beams and bars housed within a support box.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM International)
ASTM	*Standard Specification for*
A6	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
A36	Carbon Structural Steel
A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A588	High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance
A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
D395	Standard Test Methods for Rubber Property—Compression Set
D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D2240	Standard Test Method for Rubber Property—Durometer Hardness
	American Welding Society, Inc. (AWS)
D1.5	Bridge Welding Code
D1.6	Structural Welding Code—Stainless Steel
QC1	Standard for AWS Certification of Welding Inspectors
	American Association of State Highway and Transportation Officials (AASHTO)
2012 Edition	LRFD Bridge Design Specifications
2012 Edition	LRFD Bridge Construction Specifications
M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

M 164	Standard Specification for High-Strength Bolts for Structural Steel Joints
M 232	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
	Port Authority Standard Specifications
Section 05120	Structural Steel
Section 09910	Painting

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design the bearing assemblies based on the current AASHTO LRFD Bridge Design Specifications, including latest interims.

B. Design and detail the expansion joint system with adequate access to all internal components in order to assure the feasibility of inspection and maintenance activities.

C. Design and detail the expansion joint system to minimize concrete cracking above the support boxes. Take measures to include, but not be limited to, assuring adequate support box top plate thickness, specifying any additional bridge deck steel reinforcement required, and providing adequate concrete cover.

D. Detail the expansion joint system and bridge deck steel reinforcement to assure that adequate concrete consolidation can be achieved underneath all support boxes.

E. Do not allow the expansion joint seals to protrude above the top of the expansion joint system under any service condition. Split extrusions may be used at curb upturns.

F. Design the elastomeric or urethane springs and bearings to be removable and replaceable. The removal and reinstallation of each strip seal shall be easily accomplished from above the joint with a 1-1/4 inch minimum gap width. These operations shall be viable with a one lane partial closure of the bridge deck.

G. Design and detail the expansion joint system to be watertight.

H. Design and detail the expansion joint system to accommodate all movements specified in the Contract Drawings.

I. Design and detail the expansion joint to mitigate the potential for fatigue damage wherever centerbeam field splices are required. Consider reducing support box spacing and optimizing splice location between adjacent support boxes in order to minimize fatigue stress range at field splices.

J. Design Axle Loads and Impact Factors

1. Design the centerbeams, support bars, bearings, connections, and other structural components for the simultaneous application of vertical and horizontal loads from a tandem axle. The tandem axle consists of a pair of axles spaced four feet apart with vertical and horizontal loads as specified below. The transverse spacing of the wheels is six feet. The distribution of the wheel load among center beams is as specified in the Distribution of Wheel Loads subsection of this specification.

2. Use a 32.0 kip tandem as the vertical load range for fatigue design. This tandem consists of two 16.0 kip axles spaced four feet apart. Only one of these tandem axles must be considered in the design, unless the joint opening exceeds four feet. Increase this load range by a dynamic load allowance (Impact Factor) of 75%. Apply load factors in accordance with Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims.

3. Use a 50.0 kip tandem as the vertical load for strength design. This tandem consists of two 25.0 kip axles spaced four feet apart. Only one of these tandem axles must be considered in the design, unless the joint opening exceeds four feet. Increase this load by a dynamic load allowance (Impact Factor) of 75%. Apply load factors in accordance with Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims.

4. The horizontal load range for fatigue design is 20 percent of the amplified vertical load range (LL+IM) specified above. For modular expansion joint systems installed on vertical grades in excess of five percent, add the horizontal component of the amplified vertical load range (LL+IM) specified above to this horizontal load range.

5. The horizontal load for strength design is 20 percent of the amplified vertical load (LL+IM) specified above. For modular expansion joint systems installed on vertical grades in excess of five percent, add the horizontal component of the amplified vertical load (LL+IM) specified above to this horizontal load.

K. Distribution of Wheel Loads

1. The following table specifies the centerbeam distribution factor as a function of centerbeam top flange width. This factor is the percentage of the design vertical axle load and the design horizontal axle load which is applied to an individual centerbeam for the design of that centerbeam and its associated support bars. Interpolate distribution factors for centerbeam top flange widths between those explicitly denoted in the table. In no case shall the distribution factor be taken as less than 50%. Divide the remainder of the load equally and applied to the two adjacent centerbeams or edge beams.

Width of Centerbeam Top Flange	Distribution Factor
2.5 inches	50%
3.0 inches	60%
4.0 inches	70%
4.75 inches	80%

L. Fatigue Limit State Design Requirements

1. Design the modular expansion joint system structural members, bolted and welded splices and connections, and attachments to resist the Fatigue Limit State load combination specified in Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims. Apply the vertical and horizontal load ranges specified in the Design Axle Loads and Impact Factors subsection of this specification simultaneously. Distribute these loads as specified in the Distribution of Wheel Loads subsection of this specification.

2. Obtain the nominal stress ranges, Δf, at all fatigue critical details from a structural analysis of the expansion joint system applying the design vertical and horizontal load ranges specified in the Design Axle Loads and Impact Factors subsection of this specification and distribute as specified in the Distribution of Wheel Loads subsection of this specification. Analyze the expansion joint system with a minimum gap opening corresponding to the midrange configuration (at least half of the maximum gap opening). Apply the design axle load as two wheel loads, each having a transverse width of 20 inches.

3. For each detail under consideration, position the wheel loads transversely on a centerbeam to achieve the maximum nominal stress range at that detail. Apply the vertical and horizontal wheel loads as line loads to the top of the centerbeams at their centerlines. Calculate the design stress range in the centerbeam-to-support bar connection as specified below. Use the design nominal stress ranges, Δf, for fatigue design as specified at the end of this subsection.

a. Welded or Bolted Single-Support-Bar Systems

(1) The nominal stress range, Δf, in the centerbeam at a welded or bolted stirrup is the sum of the longitudinal bending stress ranges at the critical section resulting from vertical and horizontal loading. Do not consider the effects of stresses in any load-bearing attachments such as the stirrup or yoke when calculating the longitudinal stress range in the centerbeam. For bolted single-support-bar systems, calculate stress ranges using the net section.

(2) Calculate the nominal stress range, Δf, in the stirrup or yoke without considering the effects of stresses in the centerbeam. Calculate the stress range by assuming a load range in the stirrup equal to 30% of the total vertical reaction force between the centerbeam and the support bar. The effects of horizontal loads may be neglected in the design of the stirrup.

b. Welded Multiple-Support-Bar Systems

(1) Three locations have been identified as initiation sites for fatigue cracking at a centerbeam-to-support bar welded connection. The types of cracking associated with these three locations are described below. The corresponding equations may be used to calculate the nominal stress range, Δf. For the support bar, either the reduced moment at the critical cross section or the moment at the centerline of the connection may be used in these equations.

(a.) Centerbeam Weld Toe Cracking: Centerbeam weld toe cracking is driven by a combination of longitudinal bending stress range, SRB, in the centerbeam, and vertical stress range, SRZ, at the top of the connection weld.

Calculate the longitudinal bending stress range, SRB, at the bottom of the centerbeam as:

$$S_{RB} \equiv M_{Vcb} / S_{Xcb} + M_{Hcb} / S_{Ycb}$$

Calculate the vertical stress range, SRZ, at the top of the connection weld as:

$$S_{RZ} \equiv R_H \cdot Dcb / S_{Wtop} + R_v / A_{Wtop}$$

(b.) Support Bar Weld Toe Cracking: Support bar weld toe cracking is driven by a combination of longitudinal bending stress range, SRB, in the support bar and vertical stress range, SRZ, at the bottom of the connection weld.

Calculate the longitudinal bending stress range, SRB, at the top of the support bar as:

$$S_{RB} \equiv M_{Vsb} / S_{Xsb} + 0.5 \cdot R_H \cdot (D_{cb} + H_W + 0.5 \cdot D_{sb}) / S_{Xsb}$$

Calculate the vertical stress range, SRZ, at the bottom of the connection weld as:

$$S_{RZ} \equiv R_H \cdot (D_{cb} + H_W) / S_{wbot} + R_V / A_{Wbot}$$

(c.) Weld Throat Cracking: Weld throat cracking is driven by a vertical stress range at the weld throat.

Calculate the vertical stress range, SRZ, at mid-height of the connection weld as:

$$S_{RZ} \equiv R_V / A_{wmid} + R_H \cdot (d_{cb} + 0.5 \cdot h_W) / S_{Wmid}$$

In the above equations:

R_V = vertical reaction at the connection weld

R_H = horizontal reaction at the connection weld

M_{Vcb} = bending moment in the centerbeam due to applied vertical forces

M_{Hcb} = bending moment in the centerbeam due to applied horizontal forces

M_{Vsb} = bending moment in the support bar due to applied vertical forces

S_{Xcb} = section modulus at bottom of the centerbeam about horizontal axis

S_{Ycb} = section modulus of the centerbeam about vertical axis

S_{Xsb} = section modulus at top of the support bar about horizontal axis

A_{Wtop} = area of the weld at the top of the connection

A_{Wmid} = area of the weld at the middle of the connection

A_{Wbot} = area of the weld at the bottom of the connection

S_{Wtop} = section modulus of the weld at the top of the connection

S_{Wmid} = section modulus of the weld at the middle of the connection

S_{Wbot} = section modulus of the weld at the bottom of the connection

H_W = height of the weld

D_{cb} = depth of the centerbeam

D_{sb} = depth of the support bar

Calculate the nominal stress range, Δf, at welded multiple-support-bar connection details for each case above as follows:

$$\Delta f = (S_{RB}^2 + S_{RZ}^2)^{1/2}$$

where:

S_{RB} = longitudinal stress range in the centerbeam or support bar, as calculated for each specific case above.

S_{RZ} = vertical stress range in the centerbeam-to-support bar connection weld, as calculated for each specific case above.

To assure an infinite fatigue life, all modular expansion joint system structural members, connections (bolted and welded), splices, and attachments shall satisfy the following:

$$\Delta f \leq F_{TH} / 2$$

where:

Δf = the nominal stress range as specified at the beginning of this subsection.

F_{TH} = constant amplitude fatigue threshold (CAFL) as specified in the Fatigue Resistance Characterization Requirements subsection of this specification.

4. Fatigue Resistance Characterization Requirements

a. Characterize the fatigue resistance of all details in terms of the detail categories specified in Table 6.6.1.2.5-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims. Many details composing modular expansion joint systems may clearly correspond to specific structural details depicted in Figure 6.6.1.2.3-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims. In these cases, the applicable fatigue categories specified in Table 6.6.1.2.3-1 may be used for design. In cases where the Engineer establishes that a detail does not clearly correspond to a structural detail depicted in Figure 6.6.1.2.3-1, conduct fatigue testing of specimens exhibiting that detail, in accordance with the Fatigue Testing of Metallic Structural Components and Connections, Durability Testing of Elastomeric Support Bearings, Fatigue Testing Laboratory and Fatigue Testing Reference subsections of this specification, to establish the appropriate constant amplitude fatigue limit (CAFL) for that detail.

5. Strength I Limit State Design Requirements

a. Design modular expansion joint system structural steel members, connections (bolted and welded), splices, and attachments to resist the Strength I Limit State load combination specified in Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims. Apply the vertical and horizontal loads specified in Design Axle Loads and Impact Factors subsection of this specification simultaneously. Distribute these loads as specified in the Distribution of Wheel Loads subsection of this specification.

M. Design Reference

1. Provisions contained in Design Axle Loads and Impact Factors, Distribution of Wheel Loads, Fatigue Limit State Design Requirements, Fatigue Resistance of Details, and Strength I Limit State Design Requirements subsections of this specification have been developed from research summarized in National Cooperative Highway Research Program Report 402."Fatigue Design of Modular Bridge Expansion Joints", National Academy Press, Washington DC, 1997.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The expansion joint manufacturer shall have at least three years of experience in designing and manufacturing modular expansion joint systems. Provide written certification of the manufacturer's experience to the Engineer. This certification shall include the location of each bridge, installation date, governmental agency/owner, and the name, address, and telephone number of each owner's/agency's representative.

2. Submit the name of the selected expansion joint system manufacturer to the Engineer within 10 days of contract award. Once the name of the manufacturer has been submitted to the Engineer, no alternative expansion joint system manufacturer made unless the selected manufacturer demonstrates an inability to meet the requirements of this specification.

3. Do not begin preparation of the design calculations and shop plans until receiving the Engineer's written approval of the expansion joint manufacturer's certification of experience.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS AND SOURCES OF SUPPLY

A. Acceptable Manufacturers

1. Only manufacturers whose modular expansion joint systems have met the requirements specified in the Fatigue Resistance Characterization Requirements subsection of this specification will be permitted to supply modular expansion joint systems.

   a. Complete any testing required to establish the fatigue resistance of all details of a specific proprietary system prior to the contract award date.

   b. Conduct all fatigue testing in accordance with the Fatigue Testing of Metallic Structural Components and Connections, Durability Testing of Elastomeric Support Bearings and Fatigue Testing Laboratory subsections of this specification.

   c. Complete testing on any revised details or material substitutions of a previously prequalified system prior to the contract award date.

2. The following manufacturers are known to have prequalified modular expansion joint system details having completed fatigue testing in accordance with the requirements of this specification:

   a. The D.S. Brown Company
   P.O. Box 158
   300 E. Cherry Street
   North Baltimore, Ohio 45872-0158
   Tel. (419) 257-3561
   Fax (419) 257-2200

   b. Watson Bowman ACME Corporation
   95 Pineview Drive
   Amherst, New York 14228-2166
   Tel. (716) 691-7566
   Fax (716) 691-9239

2.02 MATERIALS

A. Use structural steel conforming to ASTM A36, ASTM A572 Grade 50, or ASTMA 588. Do not use aluminum components.

B. Use stainless steel conforming to ASTM A240 Type 304.

C. Use bolts and other hardware conforming to the requirements of AASHTO M 164 Type 1 or 2. Galvanize bolts and other hardware in accordance with AASHTO M 232.

D. Use 100% virgin Teflon PTFE, woven PTFE fabric, or dimpled PTFE conforming to the requirements of Section 18.8 of the AASHTO LRFD Bridge Construction Specifications, current edition and latest interims.

E. Use expansion joint strip seals conforming to the following:

Property	Test Method	Range of Values
Hardness, Durometer A	ASTM D2240	55 -70
Tensile Strength	ASTM D412	2000 psi minimum
Elongation at break	ASTM D412	250%
Compression Set, at 72 hr. at 212F	ASTM D395	40%

F. 3.25 inches is the maximum size of each expansion joint strip seal. Box-type seals or seals utilizing double webs will not be acceptable. Use seals that are continuous without splices.

2.03 General Fabrication Requirements

A. Fabricate the expansion joint systems consistent with the details, dimensions, material specifications, and procedures delineated in the approved shop drawings. All fabrication procedures shall be in conformance with the specification.

B. Fabricate all expansion joint systems by the same manufacturer.

C. Weld metallic attachments used to secure elastomeric seals to the centerbeams, if welded to the centerbeams and edge beams, continuously along both their top and bottom edges.

D. PTFE Sliding Surfaces

1. Bond all PTFE under controlled conditions and in strict accordance with written instructions provided by the PTFE manufacturer.
2. All PTFE surfaces shall be smooth and free of bubbles after completion of bonding operations.

E. Stainless Steel Sliding Surfaces

1. Polish all stainless steel sliding surfaces in contact with PTFE to a Number 8 mirror finish in accordance with ASTM A480.
2. Weld each stainless steel sheet to the steel backing plate in accordance with AWS Specification D1.6. Clamp the stainless steel sheet to provide full contact with the steel backing plate during welding. Do not allow the welds to protrude above the sliding surface of the stainless steel sheet.

F. Corrosion Protection

1. Protect all steel surfaces, except those surfaces beneath stainless steel sheet, those to be bonded to PTFE, or those in direct contact with strip seals, against corrosion by one of the following methods:
   a. Hot-dip galvanized in accordance with AASHTO M 111.
   b. Paint in accordance with Section 09910 of the specifications. Paint the surfaces embedded in concrete only with a shop coat of inorganic zinc silicate paint.

2.04 Fatigue Testing of Metallic Structural Components and Connections

A. This test procedure is acceptable for, and specifically applicable to, establishing the fatigue resistance of the centerbeam-to-support bar connection in modular expansion joint systems. It is applicable to single-support-bar and multiple-support-bar systems having either welded or bolted centerbeam-to-support bar connections. The same methodology may be applied to establish the fatigue resistance of other modular expansion joint metallic structural component details, including centerbeam splices.

B. Each fatigue test generates a discrete datum. Each datum comprises an applied constant amplitude nominal stress range, Sr, and the corresponding number of cycles, N, associated with either a predetermined extent of crack propagation, defined as failure, or with termination of the test, defined as runout. Acquire ten data points for each connection detail. All data shall be in the very long life range, corresponding as closely to the constant amplitude fatigue limit (CAFL) as practical. Specifically, the number of cycles, N, associated with each datum, shall be no less than one order of magnitude less than N_{min} corresponding to the detail category specific CAFL specified in the Interpretation of Fatigue Test Data subsection of this specification. For example, to characterize a detail as Detail Category C, the tested number of cycles, N, shall exceed 4.4×10^5 for each datum.

C. Calculate the constant amplitude nominal stress range at the anticipated initiation location of an incipient crack. Calculate nominal stresses using conventional equations for analyzing bending and axial load. These equations are essentially the same as those used in strength design. The stress concentration effects of a weld, bolt hole, or other local features are not explicitly embodied in the conventional nominal stress equations.

D. Establish the appropriate AASHTO detail category applicable to fatigue design by comparing acquired test data to fatigue resistance graphs representing the AASHTO detail categories.. The constant amplitude fatigue limit (CAFL) applicable to fatigue design corresponds to the AASHTO detail category fatigue resistance graph representing a lower bound of the experimentally acquired data.

E. When testing is conducted exclusively in the infinite life regime and more stringent test data scatter requirements are satisfied, a unique CAFL (different from those CAFL corresponding to specific detail categories specified by AASHTO) may be established for fatigue design.

F. Specimens

1. Specimens selected for testing shall be full-scale centerbeam and support bar assemblies or subassemblies representative of those installed in field applications. A subassembly is defined as a specimen having the same physical and geometric properties as an assembly but having a reduced number of centerbeams.

2. Each specimen shall consist of three continuous centerbeam spans over four equally spaced support bars. Centerbeam spans between adjacent support bar centerlines shall be a minimum of 3'-0" and a maximum of 4'-6". Support bar spans shall be a minimum of 3'-0" and a maximum of 3'-8". Locate the centerbeam-to-support bar connection being tested at the mid-span of each support bar.

3. Fabricate any welded or bolted attachments used to secure equidistant springs to a support bar, centerbeam, or stirrup as an integral part of the specimen. Provide a rigid load path to the test fixture to resist any horizontal forces or displacements which would normally be resisted through these attachments in a field installation. Fabricate any miscellaneous welded or bolted attachments, including welded attachments used to secure the expansion joint strip seals to the centerbeams, as integral parts of the specimen.

4. Orient support bars of subassembly specimens that are components of single-support-bar swivel-joist type modular expansion joint systems perpendicular to the longitudinal axis of the centerbeam.

5. Visually inspect, prior to testing, each specimen for any defects, loose fasteners or other aberrations which could plausibly affect the tested fatigue resistance. Define defects and flaws in accordance with the appropriate governing specification (ASTM A6, AWS D1.5, etc.). Exclude data acquired from specimens containing such anomalies from consideration except as permitted in the Finite Life Regime Testing subsection of this specification. Report any observed anomaly with its corresponding data in the tabular format stipulated in the Data Reporting for Fatigue Tests subsection of this specification.

G. Instrumentation

1. Sufficiently instrument each specimen to measure the static nominal strain range within that specimen for a specific applied load range. Best results can generally be obtained when the applied load range for the static calibration tests does not pass through zero load. Make strain measurements at locations a sufficient distant from local effects, such as weld toes or bolt holes, which could significantly influence acquired test data.

2. Install, as a minimum, eight strain gages on the centerbeam top flange in the vicinity of each centerbeam-to-support-bar connection. Install these gages in pairs on each side of the connection at distances of one and two times the depth of the centerbeam from the centerline of the connection. Locate each pair of strain gages symmetrically about the centerline of the centerbeam. As a minimum, also install two strain gages on the support bar bottom flange in the vicinity of each centerbeam-to-support bar connection. Install one of these strain gages on each side of the connection at a distance equal to the depth of the support bar from the centerline of the connection. Install these strain gages along the centerline of the support bar.

H. Test Fixtures

1. Adequately support and secure test fixtures to the specimen throughout the duration of the test. Design and fabricate the fixture to such tolerances as required to assure that additional stresses will not be generated in the specimen as a consequence of fixture misalignment. Accommodate mismatches resulting from specimen fabrication errors by shimming or other such means precluding the application of force to the specimen.

2. Typical elastomeric bearings and springs used to transfer vertical loads from the support bars to the support boxes may be replaced with steel bearings in the test fixture. This modification will enable fatigue testing at higher load ranges and different frequencies than those encountered during normal service conditions.

3. Apply load through two 10 inch long patches. Comprise each patch typically of a steel plate and a hard rubber bearing pad placed in contact with the bottom flange of the centerbeam. Locate each patch at mid-span of each outer span.

4. Apply a minimum of 10 kips at each patch location in order to assure adequate seating of the specimen to the test fixture. This requirement is waived for tests of single support bar systems conducted using load reversal. Once this load has been applied, rebalance all strain measuring devices to zero strain while the preload is maintained. Apply an additional load approximately equivalent to the calculated load range. Measure strain ranges for the load range from 10 kips to the peak load. Repeat each static calibration test three times while still maintaining a minimum 10 kips load at each load patch. The measured strain ranges from each repetition should vary by no more than 25% from the mean value. If the stress ranges are not repeatable, make appropriate modifications to the test fixture.

I. Static Calibration Test

1. Prior to any fatigue resistance testing, perform a static calibration test in order to validate the structural analysis model. Perform the static calibration test after attainment of stress range repeatability as described in the Test Fixtures subsection of this specification. Consider the structural analysis model validated when calculated strain ranges are within ±25% of the measured strain ranges at every strain gage location.
2. For the purpose of reporting nominal fatigue resistance stress ranges at specific details, stress ranges determined through structural analysis of the model are preferred over stress ranges acquired directly from test measurements.

J. Fatigue Test Procedure

1. A minimum of ten data points are required to establish the fatigue resistance of each detail. Consider the centerbeam-to-support bar connection as a single detail.
2. Several data points may be obtained from a single specimen by repairing the cracked sections of that specimen and resuming testing. Such repairs shall have minimal effect on the stress ranges at un-failed details still being tested. Discard data points derived from tests in which a repaired detail cracks again.
3. All data shall be in the very long life range, corresponding as closely to the constant amplitude fatigue limit as practical, but in no case less than 200,000 cycles. Either finite life regime or infinite life regime testing may be conducted. For infinite life regime testing, the number of cycles, N, associated with each of the ten data shall be at least twice the number of cycles, N_{min}, designated in the table in the Interpretation of Fatigue Test Data subsection of this specification.
4. Apply loads using hydraulic actuators or other similar loading devices. Maintain and continuously monitor the magnitude of the vertical load range, ΔP_v, throughout the duration of the test. Apply vertical and horizontal load ranges to the specimen simultaneously. The horizontal load range shall always be equal to 20% of the vertical load range, ΔP_v. This horizontal-to-vertical load ratio may be maintained by inclining the specimen 11.3 degrees with respect to the horizontal plane and applying load through vertically oriented actuators.
5. For multiple support bar systems, either exclusively tension or exclusively compression the loading mechanism s and apply the load at a constant amplitude at any desired frequency. Direct the applied load range in a direction such that the reaction force between the centerbeam and support bar is always tensile. The load range shall not pass through zero load. Maintain minimum preload throughout the duration of the test.

6. Single support bar systems may be loaded using the same procedures as those for multiple support bar systems. If premature stirrup failure occurs, an applied load range of 70% compression and 30% tension may be used.

7. Do not use the load ranges in the test that are so large as to alter the observed failure mode from that which would be observed under service conditions. Under no circumstance shall imposed stress exceed the yield stress of the material in any portion of the specimen. Test each specimen using at least two different load (stress) ranges.

8. If infinite life regime testing is conducted, choose the first load range so that the applied stress range is just above the postulated CAFL. Decrease the load range in the subsequent test if failure resulted and increased if the test resulted in a runout. A suggested increment in load is such that the stress range is increased or decreased by 2 ksi. Select the applicable CAFL from those CAFL values corresponding to the AASHTO fatigue categories. The selected CAFL is the one just below the lowest stress range that resulted in cracking.

K. Fatigue Test Failure Criteria

1. Welded Centerbeam-to-Support Bar Connections

a. Centerbeam weld toe cracking originates at or near the centerbeam weld toe, propagates up into the centerbeam at some angle, and grows back over the connection. These cracks typically grow at an angle of about 45 degrees. Consider a specimen as failed due to this type of cracking when the crack has grown on any vertical face a length from the point of origin equal to half of the centerbeam depth.

b. Support bar weld toe cracking originates at or near the support bar weld toe, propagates down into the support bar, and grows back under the connection at some angle, typically about 45 degrees F. Consider a specimen as failed due to this type of cracking when the crack has grown on any vertical support bar face a length from the point of origin equal to half of the depth of the support bar.

c. Weld throat cracking originates in the weld throat and typically grows in a plane parallel to the longitudinal axis of the support bar at about mid-depth of the weld throat. Consider a specimen as failed due to this type of cracking when a complete fracture of the weld throat has occurred. These cracks have been observed to turn down into the support bar, but only after significant growth. In such instances, apply the criteria for support bar weld toe cracking.

2. Welded Stirrup Connections

a. Consider a specimen as failed when cracks result in the complete fracture of any stirrup leg or when cracks originating at or near a stirrup weld have grown into any face of the centerbeam a length from the stirrup weld toe equal to half of the centerbeam depth.

3. Bolted Centerbeam-to-Support Bar Connections

a. Consider a specimen as failed when:

(1) Fatigue cracks which have grown out of a bolt hole have resulted in the complete fracture of the tension flange of the centerbeam.

(2) Fatigue cracks which have grown out of a bolt hole have extended into any face of the centerbeam web a distance equivalent to half of the centerbeam depth less the centerbeam flange thickness.

(3) Any portion of a stirrup fractures completely.

(4) Any single bolt fractures completely.

L. Alternate Criteria for Termination of a Finite Life Regime Fatigue Test

1. A test may also be terminated when, for a given stress range, the specimen has survived the number of cycles required to plot the data above either a particular fatigue resistance curve or the maximum permitted in the Finite Life Regime Testing subsection of this specification. For example, if the applied stress range is 17 ksi and the desired fatigue resistance curve is Category C, then based upon the equation presented in the Interpretation of Fatigue Test Data subsection of this specification, the test may be terminated after application of about 900,000 cycles provided that the specimen has not failed based on the above described criteria.

M. Nominal Stress Range Calculation

1. Welded Centerbeam-to-Support Bar Systems

a. Calculate the nominal stress range for centerbeam weld toe cracking by taking the square root of the sum of the squares of the longitudinal bending stress range in the centerbeam and the vertical stress range at the top of the weld.

b. Calculate the nominal stress range for support bar weld toe cracking by taking the square root of the sum of the squares of the longitudinal bending stress range in the support bar and the vertical stress range at the bottom of the weld.

c. Calculate the nominal stress range for weld throat cracking vertical stress range in the throat of the weld.

d. Calculate the nominal stress range in the centerbeam at a welded stirrup as the summation of the longitudinal bending stress ranges at the critical section resulting from vertical and horizontal loading. Use the entire load range in the calculation, even if the loading is partly in compression. Do not consider the effects of stresses in any load-bearing attachments such as the stirrup or yoke when calculating the nominal stress range in the centerbeam.

e. Take the load range in the stirrup itself as 30% of the total vertical load range carried through the connection. The effect of horizontal forces may be neglected.

2. Bolted Centerbeam-to-Support Bar Systems

a. Take the nominal stress range in the centerbeam as the summation of the longitudinal bending stress ranges in the centerbeam resulting from vertical and horizontal loading. Calculate nominal stress ranges using the net section. Do not consider the effects of stresses in the stirrup when calculating the nominal stress range in the centerbeam.

b. Take the nominal load range in the bolt group and the stirrup assembly as 30% of the total vertical load range carried through the connection. The effect of horizontal forces may be neglected.

3. Interpretation of Fatigue Test Data

a. Juxtapose the experimentally acquired data and graphs representing the fatigue resistance of the detail categories delineated in Section 6.6 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims, on a log-log scale. The equation representing the finite life fatigue resistance of these AASHTO detail categories is:

$$N \equiv A / (S_r\text{eff})^3$$

where:

N ≡ number of cycles to failure.

$S_{r,eff}$ ≡ nominal effective stress range representing fatigue resistance.

A ≡ constant defined in Table 6.6.1.2.5-1 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims.

b. The minimum number of cycles associated with infinite fatigue life, N_{min}, and the corresponding constant amplitude fatigue limit (CAFL) for each AASHTO detail category is designated in the table below.

Detail Category	N_{min} (infinite fatigue life)	CAFL (ksi)
A	1.8×10^6 cycles	24
B	3.0×10^6 cycles	16
B'	3.5×10^6 cycles	12
C	4.4×10^6 cycles	10
C'	2.5×10^6 cycles	12
D	6.4×10^6 cycles	7.0
E	1.2×10^7 cycles	4.5
E'	2.2×10^7 cycles	2.6

c. Finite Life Regime Testing

(1) The number of cycles, N, to either failure or runout, associated with each of the ten data need not exceed N_{min}, designated in the table in the Interpretation of Fatigue Test Data subsection of this specification.

(2) The detail category applicable to fatigue design shall be that corresponding to the highest of the AASHTO detail category fatigue resistance graphs representing a lower bound of all ten experimentally acquired data.

(3) If all but one datum falls above a selected AASHTO S-N curve, that one datum may be discarded and replaced by three new data obtained through additional testing. Conduct the additional testing using the same stress range as that of the discarded datum. Plot the three additional data points along with the remaining nine data. The applicable detail category shall be that corresponding to the highest of the AASHTO detail category fatigue resistance graphs representing a lower bound of all twelve data, except as limited in the previous table. For any detail, only one datum may be discarded and subsequently replaced with three additional data for any set of ten original data.

(4) The maximum fatigue resistance of any detail shall not exceed that associated with the fatigue category prescribed in the table below.

Type of Detail	Maximum Permitted Category
Welded Multiple Centerbeam-to-Support Bar Connections	C
Weld Stirrup Attachments for Single Support Bar Systems	B
Bolted Stirrup Attachments for Single Support Bar Systems	D
Groove Welded Centerbeam Splices[1]	C
Miscellaneous Welded Connections[2]	C

Miscellaneous Bolted Connections	D

Footnotes:

[1] Groove welded full penetration splices may be increased to Category B if weld integrity is verified using non-destructive testing (NDT).

[2] Miscellaneous connections include attachments for equidistant devices.

(5) Do not take the fatigue resistance for stirrups welded to a centerbeam flange greater than that defined using the fatigue details defined in Section 6.6 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims. The applicable fatigue detail for the centerbeam flange and for the stirrup shall be either a "Longitudinally Loaded Groove-Welded Attachment" or a "Longitudinally Loaded Fillet-Welded Attachment", depending upon the type of connection used.

d. Infinite Life Regime Testing

(1) The applicable constant amplitude fatigue limit (CAFL) for fatigue design may be selected as the highest CAFL of the AASHTO detail categories representing a lower bound to the experimentally acquired data. The CAFL of the AASHTO detail categories are designated in the table in the Interpretation of Fatigue Test Data subsection of this specification.

(2) A unique CAFL (different from the CAFL categories delineated in Section 6.6 of the AASHTO LRFD Bridge Design Specifications, current edition and latest interims) may be established if all ten data points are within 4 ksi of that unique CAFL.

4. Data Reporting for Fatigue Tests

a. Report fatigue test results and observations in the typical S-N format (logarithm (S) vs. logarithm (N)) with the log of the stress range plotted as the ordinate (y-axis). Additionally, report the data in tabular format. The table shall contain the following information:

b. Nominal stress range at the specific detail, $S_{r,eff}$.

c. Applied load range for each patch.

d. Number of cycles at initial observation of cracking (for reporting purposes only, not included as S-N data).

e. Number of cycles at failure or termination of the test, N, and the reason for stopping the test (failure or termination).

f. Type of crack as described in the Fatigue Test Failure Criteria subsection of this specification. Provide a detailed description of the fatigue crack if the observed crack does not resemble any of the crack types described in the Fatigue Test Failure Criteria subsection of this specification.

5. Report the following information:

a. Expansion joint system type and manufacturer.

b. Drawings depicting shape, size, and dimensions of the specimen.

c. Drawings depicting fixture details, including specimen orientation.

d. Section properties and dimensions of the centerbeam and support bar.

e. Center beam-to-support bar connection details:

(1) Weld procedure specifications for welded expansion joint systems.

(2) Bolt size, material specifications, location, and method of tightening for bolted expansion joint systems.

6. Durability Testing of Elastomeric Support Bearings

a. This subsection provides guidelines for durability testing of the elastomeric support bearings typically used in modular expansion joint systems. It is not applicable to compression springs, equidistant springs, or other elastomeric components.

b. Perform tests dynamically on individual bearings. Fatigue life is evaluated by applying a displacement range to each specimen rather than a load or stress range.

c. Comprise specimens as full scale bearing components representative of those installed in field applications. Fabricate PTFE sliding surfaces or materials typically bonded to the elastomeric support bearings as an integral part of the specimen.

d. Prior to testing, visually inspect each specimen for any flaws or defects that could plausibly affect fatigue resistance. Define and record any flaws or details. Do not exclude data obtained from specimens containing such anomalies from the data set. Report observed anomalies with the test data.

e. Adequately support and secure test fixtures to the specimen throughout the duration of the test. Design and fabricate to such tolerance the fixture as required to assure that additional stresses will not be generated in the specimen as a consequence of fixture misalignment.

f. Apply loads through hydraulic actuators or other similar loading devices. Perform fatigue testing using displacement control. Continuously monitored displacement and load ranges throughout the duration of the fatigue test to assure that desired displacement range and minimum preload are maintained.

g. Apply load to the specimen through flat steel plates that are smooth and free of surface corrosion. Provide sufficient thickness to these plates to assure even load distribution to the specimen.

7. Dynamic Stiffness Test:

(1) Conduct testing on each specimen to be subjected to fatigue testing in order to establish its dynamic stiffness for at least three different loading frequencies. The maximum of these loading frequencies shall be equal to the service load frequency corresponding to a vehicle traveling at 60 mph. The loading frequency, f, shall be calculated as:

$$f \equiv 0.5 \cdot V / (g + b)$$

where

$V \equiv$ vehicle speed (60 mph at service load), mph

$g \equiv$ centerbeam gap (assume mid-range configuration), inches

$b \equiv$ centerbeam width, inches

(2) Obtain the load range applied during the dynamic stiffness test from structural analysis using fatigue wheel load and wheel load distribution factors as specified in the Design Axle Loads and Impact Factors and Distribution of Wheel Loads subsections of this specification.

(3) Perform each dynamic stiffness test three times. Compare data from individual tests to assure consistency of test results.

8. Bearing Fatigue Test

a. A minimum of three fatigue tests shall be required to establish the durability of each type of bearing.

b. Conduct the fatigue test using displacement control. Apply the displacement (strain) range using a sine or other smooth waveform at any frequency less than or equal to the service load frequency calculated in the Dynamic Stiffness Test subsection of this specification. Calculate the magnitude of the applied displacement amplitude, Δ, as:

$$\Delta \equiv R_v / K$$

where

$R_v \equiv$ vertical reaction force at the support bearing as obtained from structural analysis, kips

$K \equiv$ dynamic stiffness of the support bearing as determined in the Dynamic Stiffness Test subsection of this specification, kips/inch

c. Maintain a minimum precompression strain in the specimen throughout the duration of the test. This precompression strain shall be approximately equal to that present in a support bearing in a field installation. The magnitude of the applied cyclic strain shall be at least equal to the precompression strain.

d. Record the minimum and maximum dynamic load at the beginning of the test. Monitor and periodically record the minimum and maximum dynamic load throughout the duration of the test.

e. At the end of each applied displacement cycle, hold the displacement at the precompression level for no less than one half of the period of loading in order to facilitate heat dissipation. Artificial air flow devices (electrical fans) may be used to assist heat dissipation. Excessive heat generation will adversely affect the tested fatigue life.

f. Acceptance of a specimen is having passed the fatigue test criteria after withstanding 2 million cycles of loading without failure.

g. The following criteria shall constitute failure:

(1) The elastomeric material exhibits excessive deterioration or cracking.

(2) The measured minimum dynamic load falls to 30% of the initial dynamic load recorded at test initiation.

(3) The measured dynamic load range decreases to half of the initial dynamic load range recorded at test initiation.

9. Data Reporting for Bearing Fatigue Test

a. Report data in tabular format which contains the following information for each specimen tested:

(1) Minimum (precompression) strain, maximum strain, displacement, and load at test initiation.

(2) Type of loading impulse (sine wave, ramp, etc.).

(3) Number of cycles at initial observation of distress leading to failure (for reporting purposes only, not to be included in the data).

(4) Number of cycles at failure.

(5) A description of the mode of failure.

b. Also report the following data for each specimen tested:

(1) Bearing type and manufacturer.

(2) Drawings depicting shape, size, and dimensions of the specimen including any PTFE sliding surfaces or materials bonded to the specimen.

(3) Drawings depicting fixture details, including specimen orientation.

10. Fatigue Testing Laboratory

a. Perform fatigue testing by an independent testing laboratory. The following individuals have stated that they have access to facilities capable of performing the fatigue testing:

(1) Prof. Charles W. Roeder
Department of Civil Engineering
233B More Hall
University of Washington
Seattle, WA
Tel: (206) 543-6199
Fax: (206) 543-1543

(2) Dr. John W. Fisher
ATLSS Research Center
Lehigh University
117 ATLSS Drive
Bethlehem, PA 18015-4793
Tel: (215) 758-3535
Fax: (215) 758-5553

(3) Robert J. Conner/Mark D. Bowman
Bowen Laboratory
Purdue University
1040 S. River Road
West Lafayette, IN 47907-2101
Tel: (765) 496-8272
Fax: (765) 494-9886

11. Fatigue Testing Reference

a. Provisions contained in the Fatigue Testing of Metallic Structural Components and Connections and Durability Testing of Elastomeric Support Bearings subsections of this specification have been developed from research summarized in National Cooperative Highway Research Program Report 402 "Fatigue Design of Modular Bridge Expansion Joints", National Academy Press, Washington DC, 1997.

PART 3. EXECUTION

3.01 INSPECTION

A. Subject each expansion joint system to and pass three levels of inspection in order to be accepted. These three levels are Quality Control Inspection, Quality Assurance Inspection, and Final Inspection. Provide the manufacturer both Quality Control Inspection and Quality Assurance Inspection. Provide access to the Engineer for the Final Inspection.

B. Quality Control Inspection

1. Provide quality control inspection by the manufacturer on a full time basis during the fabrication process of all major components to assure that the materials and workmanship meet or exceed the minimum requirements of the contract. Perform quality control inspection by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department.

C. Quality Assurance Inspection

1. Perform quality assurance inspection by an independent inspection agency provided by the manufacturer. Quality assurance inspection is not required to be full time inspection, but shall be performed during all phases of the manufacturing process.

D. Final Inspection

1. Final inspection of each expansion joint system will be performed by the Engineer at the job site immediately prior to installation. Provide an accessible work area for this inspection. During final inspection, the Engineer will inspect each expansion joint system for proper alignment, complete bond between expansion joint strip seals and steel components, and proper steel stud placement.
2. There shall be no bends or kinks in the steel components, except as required to follow bridge deck grades and as specifically detailed on the approved shop plans.. Straightening of unintended bends or kinks will not be permitted. Remove any expansion joint system exhibiting bends or kinks, other than those shown on the approved shop plans, from the job site and replaced with a new expansion joint system at the expense of the Contractor. Fully bond expansion joint strip seals to the steel at the expense of the Contractor.
3. Studs will be visually inspected and will be struck lightly with a hammer. Replace any stud which does not have a complete end weld or does not emit tintinnabulation when struck lightly with a hammer. Carefully remove any stud located more than one inch, in any direction, from the location specified on the shop plans and replace with a new stud welded in the proper location. All stud replacements shall be at the expense of the Contractor.

E. Acceptance

1. Each expansion joint system shall pass all three levels of inspection delineated in the Inspection subsection of this specification to qualify for acceptance. Replace or repair any expansion joint system which fails any one of the three levels of inspection at no expense to the Authority and to the satisfaction of the Engineer. Submit any proposed remedial procedures to the Engineer for approval before implementation.

2. Ascertain that the manufacturer has met the fatigue resistance characterization and prequalification requirements of the Acceptable Manufacturers and all Submittals subsections of this specification applicable to the specific expansion joint system being installed. The Contractor is responsible for any additional costs and/or time delays associated with selection of an alternative expansion joint system incurred as a result of noncompliance with these requirements, including the failure of the manufacturer to retest revised details or material substitutions of a previously prequalified system.

F. Shipping and Handling

1. Deliver the expansion joint system to the job site and stored in accordance with the manufacturer's approved shop plans.
2. Do not weld lifting mechanisms, temperature adjustment devices, and temporary anchorages to the centerbeams or edge beams.
3. Damage to the expansion joint system during shipping or handling shall be just cause for rejection of the expansion joint system.
4. Repair damage to the corrosion protection system to the satisfaction of the Engineer.

G. Installation

1. A qualified installation technician shall be present at the job site to assure proper installation of each expansion joint system. This technician shall be a full time employee of the manufacturer of the specific expansion joint system being installed. Comply with all recommendations made by the expansion joint manufacturer's installation technician as approved by the Engineer. Certify each expansion joint system manufacturer's installation technician to the Engineer that the approved installation procedures were followed. All certifications to the Engineer shall be in writing and shall be signed and dated by the manufacturer's installation technician.
2. Install each expansion joint system in strict accordance with the manufacturer's approved shop plans as stipulated in the Shop Drawings and Design Calculations Submittal subsection of this specification and the recommendations of the manufacturer's installation technician. Perform all centerbeam welded field splices by a certified welder under the direct supervision of the manufacturer's qualified installation technician as specified above. Submit the weld procedure by the manufacturer and approved in accordance with the Shop Drawings and Design Calculations Submittal subsection of this specification. The welder shall have been trained and certified for performing those approved specific welds in accordance with the current AASHTO/AWS D1.5 Bridge Welding Code.
3. Each permanently installed expansion joint system shall match exactly the finished bridge deck profile and grades.
4. Exercise care at all times to protect each expansion joint system from damage. Protect concrete blockouts and supporting systems from damage and construction traffic prior to installation of the expansion joint systems. Do not allow, after installation, construction loads on the expansion joint systems. Submit to the Engineer for approval a proposed method of bridging over each expansion joint system to accommodate any construction traffic.

5. Set each expansion joint system to a gap width corresponding to the ambient temperature at the time of setting. This information is specified in the Contract Drawings and be specified on the approved shop plans. Any mechanical devices supplied by the joint system manufacturer, for the purpose of setting the expansion joint system to the proper gap width, will remain the property of the manufacturer. When no longer required, return the devices to the manufacturer.
6. Remove all forms and debris that may impede movement of the expansion joint systems.
7. Test each expansion joint system for watertightness after installation. Flood each completely installed expansion joint system with water to a minimum depth of three inches for a duration of at least one hour. Repair the expansion joint system, if leakage is observed, to the satisfaction of the Engineer at the Contractor's expense. Prepare the repair procedure by the expansion joint system manufacturer and submit to the Engineer for approval. After repairs are completed, retest the expansion joint for leakage.

END OF SECTION

SECTION 05830

MODULAR EXPANSION JOINTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings and Design Calculations Submittals

1. Submit shop drawings and design calculations delineating the expansion joint system to the Engineer for approval prior to fabrication of the joint. The Professional Engineer responsible for preparing and stamping the submittal shall be an employee of the expansion joint system manufacturer, and shall hold a valid license in the branch of Civil Engineering from any State in the United States. At a minimum, include to following in the submittals:

   a. Plan, elevation, and section of the joint system for each movement rating and bridge deck width. Specify all dimensions and tolerances.

   b. Sections showing all materials composing the expansion joint system with complete details of all individual components including all bolted and welded splices and connections.

   c. All ASTM, AASHTO, or other material designations.

   d. Installation plan including sequence, lifting mechanisms and locations, details of temporary anchorage during setting, temperature adjustment devices, opening dimensions relative to temperature, installation details at curbs, and seal installation details.

   e. Plan for achieving watertightness including details related to performing the watertightness test required in the Installation subsection of this specification.

   f. Details and material designations pertinent to the corrosion protection system.

   g. Requirements and details related to the temporary support of the joint system for shipping, handling, and job site storage.

   h. Design calculations for all structural elements including all springs and bearings. The design calculations shall include fatigue design for all structural elements, connections, and splices.

   i. Welding procedures in compliance with the current AASHTO/AWS D1.5 Bridge Welding Code.

   j. A written maintenance and part replacement plan to facilitate replacement of parts subject to wear. This plan shall include a list of parts, instructions for maintenance inspection, acceptable wear tolerances, methods for determining wear, procedures for replacing worn parts, and procedures for replacing seals.

   k. Any required modifications to blockout reinforcing steel to accommodate the expansion joint system.

B. Documentation, Certifications, and Test Reports Submittals

1. Submit the following documentation to the Engineer with the shop plan submittal:

   a. Documentation that the manufacturer is certified through the AISC Quality Certification Program under the category Simple Steel Bridge Structures.

b. Documentation that welding inspection personnel are qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors.

c. Documentation that personnel performing nondestructive testing (NDT) are qualified and certified as NDT Level II under the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1a.

2. Submit to the Engineer for approval prior to fabrication the following test reports and certificates of compliance:

a. Manufacturer's certificate of compliance for all polytetrafluorethylene (PTFE) sheeting, PTFE fabric, and elastomer.

b. Certified mill test reports for all steel and stainless steel in the expansion joint system assemblies.

c. Certified test reports confirming that the springs and bearings meet the design load requirements.

3. Upon completion of installation, submit to the Engineer certification stating that each expansion joint system was installed in accordance with the approved shop plan installation procedure. This certification shall conform to the requirements specified in the Installation subsection of this specification.

C. Method for Temporary Bridging of Construction Loads Submittal

1. Submit to the Engineer for approval a temporary bridging method for each expansion joint system over which construction traffic is anticipated to cross following its installation. This submittal shall conform to the requirements specified in the Installation subsection of this specification.

D. Quality Assurance Inspection Documentation Submittal

1. Submit to the Engineer documentation of a Quality Assurance Inspection program performed by an independent inspection agency provided by the manufacturer. The name of the independent inspection agency, details of the proposed quality assurance inspection program including inspection frequency, and all applicable reporting forms shall be submitted to the Engineer for approval prior to the start of fabrication.

E. Warranty Submittal

1. Modular expansion joint assembly warranties and guarantees provided by the manufacturer shall be submitted to the Engineer.

END OF APPENDIX "A"

DIVISION 6

SECTION 06100

ROUGH CARPENTRY

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for rough carpentry. As used in this Section "rough carpentry" shall mean Work of the kind described in 1.01-A, and which is generally not exposed, except as otherwise shown on the Contract Drawings.

A. Types of rough carpentry specified in this section include the following:

1. Wood framing.
2. Wood furring.
3. Wood grounds, nailers, blocking and sleepers.
4. Sheathing (walls and roof).
5. Subflooring and underlayment.
6. Plywood backing panels.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	The Engineered Wood Association (APA)
APA Form No. E 30	Engineered Wood Construction Guide.
APA Form No. E 445S	Performance Standards and Qualification Policy for Structural-Use Panels.
	American Society of Mechanical Engineers (ASME)
B18.6.1	Wood Screws (Inch Series).
B18.2.1	Square and Hex Bolts and Screws, Inch Series.
	American Society for Testing and Materials (ASTM)
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A307	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
ASTM A563	Carbon and Alloy Steel Nuts.
ASTM D226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D5516	Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.

ASTM D5664	Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
1667	Driven Fasteners: Nails, Spikes, and Staples.

American Wood Preservers Association (AWPA)

AWPA Standard C 2	Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Process.
AWPA Standard C 9	Plywood – Preservative Treatment by Pressure Process.
AWPA Standard C 20	Structural Lumber – Fire-Retardant Treatment by Pressure Process.
AWPA Standard C 27	Plywood – Fire-Retardant Treatment by Pressure Process.
AWPA Standard M 4	Care of Preservative-Treated Wood Products.

Building Officials and Code Administrators International, Inc. (BOCA)

National Building Code.

Council of American Building Officials (CABO)

CABO NER-272	Pneumatic or Mechanically Driven Staples, Nails, P-Nails and Allied Fasteners for Use in All Types of Building Construction.

Redwood Inspection Service (RIS)

Standard Specifications for Grades of California Redwood Lumber.

Society of Automotive Engineers-American Iron and Steel Institute (SAE-AISI)

System for Designating Carbon and Alloy Steels.

Southern Pine Inspection Bureau (SPIB)

Standard Grading Rules for Southern Pine Lumber.

U.S. Dept. of Commerce (DOC)/National Institute for Standards and Technology (NIST)

DOC PS 1	U.S. Product Standard for Construction and Industrial Plywood.
DOC PS 20	American Softwood Lumber Standard.

West Coast Lumber Inspection Bureau (WCLIB)

Standard No. 17	Grading Rules for West Coast Lumber.

Western Wood Products Association (WWPA)

Western Lumber Grading Rules.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack materials above ground level on uniformly spaced supports to prevent deformation. Provide for air circulation within, around stacks and under temporary coverings including polyethylene and similar covering types.

1. Lumber and plywood pressure-treated with waterborne chemicals: Place a spacer between each course to provide for air circulation.

1.04 SUSTAINABLE DESIGN REQUIRMENTS

A. Sustainable Design General Requirements

The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Requirements

Lumber that is treated with less toxic borate-based chemicals in dry conditions in accordance with the low emitting materials section of Division 1 Sustainability Requirements.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Lumber

1. Lumber Standards

Lumber shall comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee's (ALSC) Board of Review. All lumber shall be certified under the Forest Stewardship Council's Principles and Criteria.

2. Grade Stamps

Lumber shall be factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at the time of surfacing and producing mill.

a. Exposed lumber shall have grade stamp applied to ends or back of each piece. Grade stamp may be omitted if a certificate of grade compliance from the inspection agency is submitted.

3. Sizing

Sizes of lumber specified herein and on the Contract Drawings are nominal, except patterned sizes shall be as shown by detail dimensions on the Contract Drawings. Actual dressed sizes are as specified in DOC PS 20, for moisture content specified for each use.

4. Surfacing: S4S (surfaced four sides) dressed lumber, unless otherwise shown on the Contract Drawings.

5. Moisture Content: Seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes less than 5 inches in nominal thickness.

6. Dimension Lumber

   a. Light framing (2 inches to 4 inches thick, 2 inches to 4 inches width): Any species of Construction grade.

   b. Structural light framing (2 inches to 4 inches thick, 2 inches to 4 inches width): Any species of No. 1 grade.

   c. Structural framing (2 inches to 4 inches thick, 5 inches width and greater): Any species of Select Structural grade.

7. Boards

   a. Exposed Boards

      Where boards will be exposed in the finished Work, maximum moisture content shall be 19 percent, "S-Dry".

      (1) Where transparent, natural, or no finish is shown on the Contract Drawings, boards shall be Redwood, Select Heart Grade per Redwood Inspection Service (RIS).

      (2) Where painted finish is shown on the Contract Drawings boards shall be No. 1 Boards per Southern Pine Inspection Bureau (SPIB) rules, Select Merchantable Boards per West Coast Lumber Inspection Bureau (WCLIB) rules, or No. 2 Common Boards and better per Western Wood Products Association (WWPA) rules.

   b. Concealed Boards

      Where boards will be concealed by other Work, maximum moisture content shall be 19 percent, "S-Dry", and one of the following species and grade:

      (1) Redwood Construction Common per RIS rules.

      (2) Southern Pine No. 2 Boards per SPIB rules.

      (3) Any species graded Construction Boards per WCLIB or WWPA rules.

   c. Board Sizes: 1 inch by 8 inch boards (for sheathing, subflooring and similar uses), or in sizes shown on the Contract Drawings.

8. Miscellaneous Lumber

   Furnish wood for support or attachment of other Work including bucks, nailers, blocking, furring, grounds, stripping and similar members. Lumber shall be of sizes and worked into shapes as shown on the Contract Drawings, and as follows:

   a. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

   b. Grade: Standard grade light framing size lumber of any species or board size lumber as required for application as shown on the Contract Drawings, No. 3 Common or Standard grade boards per WCLIB or WWPA rules or No. 3 grade boards per SPIB rules.

B. Construction Panels

1. Plywood Panel Standards

Comply with DOC PS 1 for plywood panels and, for products not manufactured under DOC PS 1 provisions, comply with APA Form No. E 445S.

2. Trademark

Each construction panel shall be factory-marked with APA trademark evidencing compliance with grade requirements.

3. Concealed APA Performance-Rated Panels

APA Performance-Rated panels complying with requirements shown on the Contract Drawings for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness, for the following applications:

a. Combination Subfloor-Underlayment: APA rated plywood Sturd-I-Floor® (APA trademark).

(1) Exposure Durability Classification: Exterior.

(2) Thickness: As shown on the Contract Drawings.

(3) Span Rating: As required to suit joist spacing shown on the Contract Drawings.

(4) Edge Detail: Tongue and groove, unless otherwise shown on the Contract Drawings.

b. Underlayment (over the above specified subfloor-underlayment, over an APA exterior rated subfloor, or for resilient tile flooring application over combination subfloor-underlayment): 1/4-inch thick, APA C-C PLUGGED exterior plywood with sanded face.

c. Wall Sheathing: APA rated plywood.

(1) Exposure Durability Classification: Exterior.

(2) Thickness: As shown on the Contract Drawings.

(3) Span Rating: As required to suit stud spacing shown on the Contract Drawings.

d. Roof Sheathing: APA rated plywood.

(1) Exposure Durability Classification: Exterior.

(2) Thickness: As shown on the Contract Drawings.

(3) Span Rating: As required to suit rafter spacing shown on the Contract Drawings.

4. Plywood Backing Panels

Telephone or Electrical Equipment Backing Panels: Fire-retardant treated, APA C-D PLUGGED INT with exterior glue, in thickness shown on the Contract Drawings, or if not otherwise shown, not less than 15/32 inch.

C. Fasteners and Anchorages

Size, type, material and finish as shown on the Contract Drawings. Furnish metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

1. Wood Screws: ASME B18.6.1
2. Bolts: ASTM A307, Grade A; with ASTM A563 hex nuts and flat washers.
3. Lag Bolts: ASME B18.2.1
4. Nails and Staples: ASTM F1667
5. Where rough carpentry is in direct contact with preservative treated wood, exposed to weather, in ground contact, or in area of high relative humidity, such as interior humidified spaces, kitchens, laundries, and showers, furnish fasteners and anchorages of AISI Type 304 stainless steel, or with a hot-dip zinc coating per ASTM A153.

D. Miscellaneous

Building Paper: ASTM D226, Type I; asphalt saturated felt, non-perforated, 15-lb. type, where shown on the Contract Drawings.

E. Preservative Treatment by Pressure Process

Lumber or plywood shown on the Contract Drawings as "Trt-Wd" or "Treated", or specified in this Section to be treated, shall comply with applicable requirements of AWPA Standard C 2 (Lumber) and AWPA Standard C 9 (Plywood). Each treated item shall be marked with a Quality Mark consistent with the ALSC Board of Review.

1. Wood shall be pressure treated with Borate Oxide (SBX) non toxic preservatives. Preservative type shall comply with AWPA P 5, and shall be as appropriate for wood type and for use shown on the Contract Drawings.
2. Minimum Preservative Retention
   a. Ground contact use: 0.40 pcf (6.4 kg/m^3)
   b. Above ground use: 0.25 pcf (4.0 kg/m^3)
3. Lumber and plywood shall be kiln-dried after treatment to a maximum moisture content of 19 percent and 15 percent, respectively. After drying, discard damaged or defective pieces as determined by the Engineer.
4. End-Cut Preservative: Where treated lumber or plywood is cut after treatment, field-coat cut surfaces with heavy brush coat of same chemical used for treatment and comply with AWPA Standard M 4.
5. The following items shall be treated in addition to those shown:
   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with flashing, vapor barriers and waterproofing.
   b. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry, concrete, or plaster.

F. Fire-Retardant Treatment by Pressure Process

Lumber or plywood shown on the Contract Drawings as fire-retardant treated wood ("FRTW"), or specified in this section to be fire-treated, shall be pressure impregnated with fire-retardant chemicals to comply with AWPA C 20 and AWPA C 27, respectively. Each treated item shall be identified with classification marking of Underwriters Laboratories, Inc., U.S. Testing, or Timber Products Inspection, indicating surface burn characteristics.

1. Flame spread rating: 0-25, per ASTM E84 when tested for a 30 minute period; flame front shall not progress more than 10-1/2 feet beyond the centerline of the test burner at any time during the test.
2. Use treatment that does not promote corrosion of metal fasteners and anchors.
3. Use AWPA treatment Type A High Temperature (HT) at interior applications, and AWPA Exterior type for exterior or interior applications.
4. Treatment type shall have been tested for strength retention after exposure to elevated temperatures; ASTM D5664 for lumber, ASTM D5516 for plywood.
5. Treatment chemicals shall be free of halogens, sulfates, ammonium sulfate, and formaldehyde.
6. Lumber and plywood shall be kiln-dried after treatment to a maximum moisture content of 19 percent and 15 percent, respectively. After drying, discard damaged or defective pieces as determined by the Engineer.
7. Treatment type shall permit end cuts and drilled holes; do not rip saw or plane surfaces of fire-retardant treated lumber.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Discard units of material with defects which might impair quality of Work, and units which are too small to use in fabricating Work with minimum joints or optimal joint arrangement.
2. Set carpentry Work to required levels and lines, with members plumb and true to line, cut and fitted.
3. Securely attach carpentry Work to substrate by anchoring and fastening as shown on the Contract Drawings, or if not shown, as required by the following:
   a. CABO NER-272 for power driven fasteners.
   b. BOCA *National Building Code,* Table 2305.2, "Fastening Schedule"
4. Countersink nail heads on exposed carpentry Work and fill holes.
5. Use common wire nails, except as otherwise shown on the Contract Drawings. Select fastener size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

B. Wood Framing

1. Install framing members of sizes and on spacings shown on the Contract Drawings, and frame openings as shown. Do not splice structural members between supports.

2. Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically furnished with the framing system used, use closely fitted wood blocks of nominal 2-inch thick lumber of the same width as framing members.

3. Construct corners and intersections with not less than 3 studs. Install miscellaneous blocking and framing as shown on the Contract Drawings and as required for support of facing materials, fixtures, specialty items and trim.

C. Wood Furring

1. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished Work. Firestop furred spaces on walls at each floor level and at ceiling line of top story, with wood blocking or non-combustible materials, accurately fitted to close furred spaces.

2. Install the following types of wood furring, where shown on the Contract Drawings:

   a. Furring to receive plywood paneling: 1 inch by 3 inch furring at 24 inches o.c., horizontally and vertically, unless otherwise shown. Select furring free from knots capable of producing bent-over nails and resultant damage to paneling.

   b. Furring to receive gypsum drywall and plaster lath: 1 inch by 2 inch furring at 16 inches o.c., vertically, unless otherwise shown.

   c. Suspended Furring: Size and spacing shown, including hangers and attachment devices. Level to a tolerance of 1/8 inch in 10 feet, except 1/4 inch in 10 feet for thick-coat plasterwork.

D. Wood Grounds, Nailers, Blocking, and Sleepers

1. Install wherever shown on the Contract Drawings, and where required for screeding or attachment of other Work. Form to shapes as shown and cut as required for true line and level of Work to be attached. Coordinate location with other Work involved.

2. Attach to substrates as required to support applied loading. Countersink bolts flush with surfaces, unless otherwise shown on the Contract Drawings. Build into masonry during installation of masonry work. Anchor to formwork before concrete placement.

3. Where plaster application is shown on the Contract Drawings, install permanent grounds of dressed, preservative treated, key-bevelled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

E. Construction Panels

1. Install in locations and thickness as shown on the Contract Drawings. Comply with applicable recommendations contained in APA's *Engineered Wood Construction Guide*, Form No. E 30 for types of construction panels and applications as shown.

2. Nail panels to framing, space 1/8 inch at edges and ends, and stagger end joints, unless otherwise shown. For subflooring-underlayment, subflooring and roofing, orient long dimension or strength axis of panel continuous across two or more framing supports, and position panel end joints over framing.

   a. Combination Subflooring-Underlayment: Panel edges not tongue-and-groove type shall be supported on 2 inch lumber blocking between joists. Sand and smooth edge joints receiving resilient flooring.

   b. Subflooring: Sand joints smooth as preparation for underlayment or finish floor.

   c. Underlayment: Butt panel joints to a close, but not tight fit (1/32 inch). Offset joints minimum of 2 inches from subfloor panels. Fill and sand edge joints receiving resilient flooring.

   d. Roof Sheathing: Install edge support as shown on the Contract Drawings, or as recommended by the APA (clips, blocking or T&G edges).

   e. Wall Sheathing: Nail to framing.

   f. Plywood Backing Panels: Nail or screw to supports.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

A. Product Data

1. Manufacturer's specifications and installation instructions for subfloor-underlayment where shown on the Contract Drawings.

2. Chemical treatment manufacturer's instruction for handling, storing, installation and finishing of treated material.

B. Certifications

1. Certification that moisture content of water-borne treated materials was reduced to specified levels prior to shipment to construction site.

a. Preservative Treatment

Certification by treating plant stating preservative solution type and pressure-process used, net amount of preservative retained and conformance with applicable standards, for each type of preservative used in the Work.

b. Fire-Retardant Treatment

Certification by treating plant that treated material complies with specified standards.

c. Design Value Compliance

Where dimensional lumber is required to comply with specific design values or minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in the form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the American Lumber Standards Committee's Board of Review.

C. Warranty

Chemical treatment manufacturer's written warranty for each treatment type.

D. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:

a. Cost breakdowns for the materials included in the Contractor's Work.
b. Cost breakdowns shall include total cost plus itemized material costs.
   1) The location (source) of the raw materials used to manufacture the supplied product(s).
   2) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.

2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.
4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).
5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.
6. Certificates of chain-of-Custody signed by manufactures certifying that products specified to be made from certified wood were made and obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2 "Principles of Criteria." Include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.

END OF APPENDIX "A"

DIVISION 7

SECTION 07204

RIGID INSULATION

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for rigid thermal insulation as follows:

1. Insulation under slab-on-grade.
2. Foundation wall insulation.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C578	Specification for Rigid, Cellular Polystyrene Thermal Insulation.
ASTM C1303	Test Method for Estimating the Long-Term Change in the Thermal Resistance of Unfaced Rigid Closed-Cell Plastic Foams by Slicing and Scaling Under Controlled Laboratory Conditions.
ASTM E84	Test Method for Surface Burning Characteristics of Building Materials.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility
Obtain each building insulation type from a single manufacturer and from a single source.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer's original packaging.

B. Protect insulation from physical damage and from becoming wet, soiled or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation, and with the following:

1. Do not expose insulation to sunlight, except to extent necessary for period of installation and concealment.
2. Do not expose insulation or adhesive to fire or heat.

1.05 SUBMITTALS

See Appendix"A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, furnish and install products of one of the following, or approved equal:

1. Extruded Polystyrene Insulation

   The Dow Chemical Co., Midland, MI, "Styrofoam"

   Owens Corning, Toledo, OH, "Foamular"

   Pactiv Corp., Lake Forest, IL, "GreenGuard"

2.02 MATERIALS

A. General

Insulation type, thickness and R-value shall be as shown on the Contract Drawings.

B. Extruded Polystyrene Board Insulation

Rigid, cellular thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process, CFC-free, complying with ASTM C578, Type IV, minimum compressive resistance of 25 pounds per square inch or type as shown on the Contract Drawings.

1. Surface Burning Characteristics

   Maximum flame spread and smoke developed indices of 10 and 250, respectively when tested in accordance with ASTM E84.

2. Thermal Resistance (R)

   15 year time-weighted average Long-Term Thermal Resistance (LTTR) as determined per ASTM C1303.

3. Edges

   Square.

2.03 ACCESSORIES

A. Adhesive for Bonding Insulation

For foundation walls, type shall be compatible with and recommended by dampproofing or waterproofing membrane manufacturer.

B. Protection Board

Asphalt impregnated and coated organic fiberboard, 1/4 inch thick, equal to W.R. Meadows, Inc. "Sealtight Protection Course", if any.

PART 3. EXECUTION

3.01 PREPARATION

Remove fins and projections greater than 1/4 inch from concrete surfaces; remove oily films, waxes, residue and other harmful substances that will be in contact with insulation, and remove substances that may interfere with the insulation attchment.

3.02 INSTALLATION

A. General

1. Extend insulation full thickness over area to be insulated. Butt edges and ends tightly. Cut and fit tightly around protrusions through plane of insulation.
2. Apply a single layer of required thickness, unless otherwise shown on the Contract Drawings.
3. Exercise care to prevent cracking. Minimize number of joints; do not install small or broken pieces. Maintain board alignment prior to backfill or slab placement.
4. Follow manufacturer's installation recommendations when extruded polystyrene will be in contact with incompatible waterproofing or dampproofing materials (solvent-based) or when in contact with hot bitumen.

B. Under-Slab and Perimeter Foundation Wall Insulation

1. Place under-slab insulation so top is flush with top of tamped and leveled aggregate base course.
2. On vertical surfaces, set units in mastic adhesive applied in accordance with the manufacturer's instructions. Stagger vertical joints, with the exception of ends at expansion joints.
3. Protect insulation on vertical surfaces by application of protection board prior to backfilling, where shown on the Contract Drawings. Set in adhesive in accordance with insulation manufacturer's recommendations.

C. NOT USED.

3.03 PROTECTION

Protect installed insulation from direct sunlight, harmful weather exposure and physical abuse, by immediate installation of concealing Work or, where that is not possible, by temporary enclosure or covering.

END OF SECTION

SECTION 07204

Rigid Insulation

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

07204C01 6-inch square sample of each rigid insulation type and protection board type in thickness specified.

Product Data

07204D01 Manufacturer"s product literature and installation instructions for insulation and accessories.

Certificates

07204E01 Manufacturer's certified test reports showing compliance with specified performance values, including R values, fire performance characteristics and compressive resistance.

END OF APPENDIX "A"

DIVISION 7

SECTION 07211

SEMI-RIGID FIBER BOARD INSULATION

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for exposed and concealed mineral fiber thermal insulation in board form.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM C 612	Specification for Mineral Fiber Block and Board Thermal Insulation.
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials.
ASTM E 119	Test Methods for Fire Tests of Building Construction and Materials.
ASTM E 136	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

Underwriters Laboratories Inc. (UL)

Fire Resistance Directory.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics

Insulation materials shall be identical to those whose indicated fire performance characteristics have been determined per test method indicated below, by Underwriters Laboratories Inc. (UL). Identify products with appropriate markings of testing and inspecting organization.

1. Surface Burning Characteristics: ASTM E 84.
2. Fire Resistance Ratings: ASTM E 119 for insulation that is part of a fire-resistance rated assembly.
3. Combustion Characteristics: ASTM E 136.

B. Single Source Responsibility

Obtain each building insulation type from a single manufacturer and from a single source.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer's original packaging.

B. Protect insulation from physical damage and from becoming wet, soiled or covered with ice or snow. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, furnish and install insulation products of one of the following, or approved equal:

Fibrex Insulations Inc., Sarnia, Ontario

IIG MinWool, LLC, Phenix City, AL

Rock Wool Manufacturing Co., Leeds, AL

Thermafiber LLC, Wabash, IN

2.02 MATERIALS

A. General

Insulating materials shall be sized to fit applications shown and to meet R-values and thicknesses shown on the Contract Drawings. Select from manufacturer's standard thicknesses, lengths and widths.

B. Semi-Rigid Mineral Fiber Board Insulation

Thermal insulation produced by combining semi-refractory mineral fibers manufactured from rock or slag with thermosetting resin binders complying with ASTM C 612, Category 2, passing ASTM E 136 for combustion characteristics of unfaced board; maximum flame spread and smoke developed indices of 15 and 0, respectively tested per ASTM E 84; low density type, unless otherwise shown on the Contract Drawings and as follows:

1. Low Density: Type IA and IB, nominal density of 4.0 pounds per cubic foot, r-value of 4.0 at 75 degrees F, maximum use temperature of 450 degrees F.

2. Medium Density: Type II, nominal density of 6.0 pounds per cubic foot, r-value of 4.16 at 75 degrees F, maximum use temperature of 850 degrees F.

3. High Density: Type III, nominal density of 8.0 pounds per cubic foot, r-value of 4.35 at 75 degrees F, maximum use temperature of 1000 degrees F.

4. Fiber Color: Manufacturer's standard, unless otherwise shown on the Contract Drawings.

C. Facings

Where shown on the Contract Drawings furnish insulation specified above with either glass mat facing or foil facing, or foil-scrim-polyethylene vapor retarder (FSP) facing on one side and black glass fiber mat on other side. Maximum flame spread and smoke developed indices shall be 25 and 50, respectively, tested per ASTM E 84.

2.03 ACCESSORIES

A. Weld Pin Anchors

Perforated plate, two inches square, welded to projecting pin, with self-locking washer, complying with the following requirements:

1. Plate: Zinc-plated steel, 0.106 inch thick.
2. Pin: Copper-coated low carbon steel, fully annealed, 0.106 inch in diameter, length to suit required depth of insulation and, with washer in place, to hold insulation tightly to substrate behind insulation.
3. Self-Locking Washer: Mild steel, 0.016 inch thick, size as required to hold insulation securely.
4. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers.
5. Anchors equal in performance to above are acceptable as approved by the Engineer.

B. Adhesive for Bonding Insulation

Product with demonstrated capability to securely bond insulation or mechanical anchors to substrates shown on the Contract Drawings without damaging or corroding insulation; anchors or substrates; "Tuff-Bond" as manufactured by Gemco, or approved equal.

PART 3. EXECUTION

3.01 EXAMINATION

Examine substrates and surface conditions to determine if conditions affecting installation of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

Clean substrates of substances harmful to insulation or vapor retarder, including removal of projections that might puncture vapor retarder or interfere with insulation placement.

3.03 INSTALLATION

A. Comply with insulation manufacturer's installation instructions applicable to products and conditions shown on the Contract Drawings.

B. Extend insulation in full thickness over entire area to be insulated. Cut and fit tightly around protrusions and fill voids with insulation.

C. Apply insulation in a single layer of required thickness, unless otherwise shown on the Contract Drawings, in multiple layers with staggered joints or as required to make up total thickness.

D. Use mechanical anchorage for permanent placement and support of insulation units. Tack weld anchors to metallic substrates and bond anchors to non-metallic substrates with adhesive unless other attachment method is shown on the Contract Drawings.

E. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness and application shown on the Contract Drawings.

F. Set foil-faced boards accurately with not less than 0.75 inch air space in front of facing. Place foil-faced side (vapor retarder) of insulation towards interior side of building.

G. Tape joints and tears in vapor retarder facing, if any, and seal each continuous area of insulation to adjacent construction to ensure an airtight installation.

H. Touch-up galvanized steel substrates damaged from welding of anchors with galvanizing repair paint in accordance with ASTM A 780.

3.04 PROTECTION

Protect installed insulation from damage due to harmful weather exposures, physical abuse and other causes. Furnish and install temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07211

SEMI-RIGID FIBER BOARD INSULATION

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

07211D01 Manufacturer's product literature, handling and installation instructions for insulation, facers, anchors, adhesives and accessories.

Manufacturer Test Reports

07211F01 Manufacturer's certified test reports showing compliance with specified performance values, including densities, R-values, fire performance characteristics and compressive resistance.

END OF APPENDIX "A"

DIVISION 7

SECTION 07212

BLANKET TYPE BUILDING INSULATION

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for faced blanket thermal insulation.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C 665	Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials.
ASTM E 119	Test Methods for Fire Tests of Building Construction and Materials.
ASTM E 136	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

Underwriters Laboratories Inc. (UL)

Fire Resistance Directory.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics

Insulation materials shall be identical to those whose indicated fire performance characteristics have been determined per test method indicated below, by Underwriters Laboratories Inc. (UL). Identify products with appropriate markings of testing and inspecting organization.

1. Surface Burning Characteristics: ASTM E 84.
2. Fire Resistance Ratings: ASTM E 119 for insulation that is part of a fire-resistance rated assembly.
3. Combustion Characteristics: ASTM E 136.

B. Single Source Responsibility

Obtain each building insulation type from a single manufacturer and from a single source.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver in manufacturer's original packaging.

B. Protect insulation from physical damage and from becoming wet, soiled or covered with ice or snow. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, furnish and install insulation products of one of the following:

CertainTeed Corp., Valley Forge, PA

Johns Manville Corp., Denver, CO

Knauf Fiber Glass, Shelbyville, IN

Owens Corning, Toledo, OH

Thermafiber LLC, Wabash, IN

2.02 MATERIALS

A. General

Insulating materials shall be sized to fit applications shown and to meet R-value and thickness shown on the Contract Drawings. Select from manufacturer's standard thicknesses, lengths and widths.

B. Faced Mineral Fiber Blanket or Batt Insulation

Thermal insulation with overlapping face tabs on both sides. Insulation produced by combining mineral fibers manufactured from glass or slag with thermosetting resins, asbestos free, complying with ASTM C 665 for Type III, Class A (blankets with reflective membrane covering), Category 1 (foil-scrim-kraft membrane acts as vapor retarder), and as follows:

1. Surface Burning Characteristics

   Maximum flame spread and smoke developed indices of 25 and 50, respectively, when tested in accordance with ASTM E 84.

2. Combustion Characteristics

   Unfaced blanket passes ASTM E 136 test.

PART 3. EXECUTION

3.01 EXAMINATION

Examine substrates and surface conditions to determine if conditions affecting installation of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

Clean substrates of substances harmful to insulation or vapor retarder, including removal of projections that might puncture vapor retarder or interfere with insulation placement.

3.03 INSTALLATION

A. Comply with insulation manufacturer's instructions applicable to products and conditions shown on the Contract Drawings.

B. Extend insulation in full thickness over entire area to be insulated. Leave no gaps or voids. Cut and fit tightly around protrusions and fill voids with insulation.

C. Apply insulation in a single layer of required thickness, unless otherwise shown on the Contract Drawings in multiple layers with staggered joints or as required to make up total thickness.

D. Apply insulation units to substrate by method shown on the Contract Drawings. If no specific method is shown, use mechanical anchorage for permanent placement and support of insulation units.

E. Set reflective foil-faced boards accurately with not less than 0.75 inch air space in front of facing. Place foil-faced side (vapor retarder) of insulation towards interior side of building.

F. Tape joints and tears in vapor retarder facing, and seal each continuous area of insulation to adjacent construction to ensure an airtight installation.

3.04 PROTECTION

Protect installed insulation from damage due to harmful weather exposures, physical abuse and other causes. Furnish and install temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07212

BLANKET TYPE BUILDING INSULATION - FOIL FACED

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

07212D01 Manufacturer's product literature, handling and installation instructions for insulation, vapor retarder and accessories.

Manufacturer Test Reports

07212F01 Manufacturer's certified test reports showing compliance with specified performance values, including R-values, densities, fire performance characteristics and water absorption ratings.

END OF APPENDIX "A"

DIVISION 7

SECTION 07270

FIRESTOPPING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies firestopping for the following applications:

1. Penetrations through fire resistance rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
4. Sealant joints in fire-resistance-rated construction.
5. Voids at the intersection of partitions with structure above.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM E 84	Surface Burning Characteristics of Building Materials
ASTM E 119	Fire Tests of Building Construction and Materials
ASTM E 136	Behavior of Materials in a Vertical Tube Furnace
ASTM E 814	Fire Tests of Through - Penetration Fire Stops

Underwriters Laboratories (UL)

Fire Resistance Directory

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated in this Specifications Section, and the passage of smoke and other gases.

B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings shown on the Contract Drawings, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.

C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where shown on the Contract Drawings and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings shown on the Contract Drawings, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

E. For firestopping exposed to traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

G. Conditions Requiring Firestopping

1. General:

a. Provide firestopping for conditions specified whether or not firestopping is shown on the Contract Drawings, and, if shown, whether such material is designated as insulation, safing or otherwise.

b. Insulation types specified in other Sections of the Specifications shall not be installed in lieu of firestopping material specified herein.

2. Building Exterior Perimeters:

a. Where exterior facing construction is continuous past a structural floor, and a space (i.e. construction joint) would otherwise remain open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide firestopping to equal the fire resistance of the floor assembly. Mineral wool by itself is not an acceptable firestop. If mineral wool is part of firestop system, the mineral wool must be completely covered by appropriate thickness of UL or Warnock Hersey listed firestop sealant.

b. Firestopping shall be provided whether or not there are any clips, angles, plates, or other members bridging or interconnecting the facing and floor systems, and whether or not such items are continuous.

c. Where an exterior wall of composite type construction passes a perimeter structural members, such as a girder, beam, or strut and the finish on the interior wall face does not continue up too close with the underside of the structural floor above, thus interrupting the fire-resistive integrity of the wall system, and a space would otherwise remain open between the interior face of the wall and lower edge of the structural members, provide firestopping to continuously fill such open space.

3. Interior Walls and Partitions:

a. Construction joints between top of fire rated walls and underside of floors above, shall be firestopped.

b. Firestop system installed shall have been tested by either UL or Warnock Hersey, including exposure to hose stream test and including for use with steel fluted deck floor assemblies.

c. Firestop system used shall allow for deflection of floor above.

4. Penetrations:

a. Penetrations include conduit, cable, wire, pipe, duct, or other elements that pass through one or both outer surfaces of a fire rated floor, wall or partition.

b. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814 (UL 1479).

c. These requirements for penetrations shall apply whether or not sleeves have been provided. Firestop the annular space between sleeve and surrounding surfaces.

5. Provide firestopping to fill miscellaneous voids and openings in fire rated construction in a manner essentially the same as specified herein.

1.04 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction, as though the Authority were a private corporation.

2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

b. Through-penetration firestop systems correspond to those shown on the Contract Drawings by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, or by another qualified testing and inspecting agency.

3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:

a. Fire-Resistance Ratings of Joint Sealants: As shown on the Contract Drawings by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.

b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.

B. Information on Contract Drawings referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Engineer's prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction, as though the Authority were a private corporation.

C. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design, and extent to that shown on the Contract Drawings for Work of this Contract and that has performed successfully.

D. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

E. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition shown on the Contract Drawings from a single manufacturer.

F. Field-Constructed Mockup: Prior to installing firestopping, erect mockups for each different through-penetration firestop system shown on the Contract Drawings to verify selections made and to demonstrate qualities of materials and execution. Build mockups to comply with the following requirements, using materials shown on the Contract Drawings for final installations.

1. Locate mockups on site in locations shown on the Contract Drawings or, if not shown on the Contract Drawings, as directed by Engineer.

2. Notify Engineer 1 week in advance of the dates and times when mockups will be erected.

3. Obtain Engineer's acceptance of mockups before start of final unit of Work.

4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work.

   a. When directed, demolish and remove mockups from Project site.

   b. Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

G. Provide firestopping products containing no asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

H. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

J. Engineer may employ and pay a qualified inspection agency to check installed firestopping systems for compliance with requirements.

K. Sequencing and Scheduling

   1. Notify Engineer at least 1 week in advance of firestopping installations; confirm dates and times on days preceding each series of installations.

   2. Do not cover up those firestopping installations that will become concealed behind other construction until Engineer and authorities having jurisdiction, if any, have examined each installation.

1.05 ENVIRONMENTAL CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

A. Endothermic, Latex Sealant:

1. LC-150 Firestop Sealant; Specified Technologies, Inc.; Somerville, NJ;
2. 3M Fire Dam 150; 3M Company, Construction Markets Division; St. Paul, MN;
3. Tremstop Acrylic Latex; Tremco, Inc.; Cleveland, OH.

B. Endothermic, Latex Compounds:

1. LC-150 Firestop Compound; Specified Technologies, Inc.;
2. 3M Fire Dam 150; 3M Company, Construction Markets Division.

C. Firestop Sleeve:

1. Biostop Pipe Collars; Bio Fireshield, Inc.;
2. Metacaulk Universal Collar 880; The RectorSealCorporation;
3. 3M Plastic Pipe Devices; 3M Company, Construction Markets Division;
4. Fyre Can; Tremco, Inc.; Cleveland, OH.

D. Intumescent Latex Sealant:

1. Biostop 700 Spray Applied Mastic, Bio Fireshield, Inc.;
2. LBC Latex Based Caulk; Nelson Firestop Products; Tulsa, OK;
3. Metacaulk 950; The RectorSeal Corporation;
4. Metacaulk 1000 Spray Applied Mastic; The RectorSeal Corporation;
5. SSS-100 Firestop Sealant; Specified Technologies, Inc.;
6. 3M CP 25 WB+; 3M Company, Construction Markets Division;
7. Tremstop WBM G; Tremco, Inc.; Cleveland, OH.

E. Intumescent Putty:

1. Biostop Fire Rated Putty Stix/Pads; Bio Fireshield, Inc.;
2. FSP Firestop Putty; Nelson Firestop Products;
3. Metacaulk Fire-Rated Putty Sticks/Pads; The RectorSeal Corporation;
4. SSP-100 Firestop Putty; Specified Technologies, Inc.;
5. 3M Moldable Putty+ (Stix/Pads); 3M Company, Construction Markets Division;
6. Tremco Flowable Putty; Tremco, Inc.; Cleveland, OH.

F. Intumescent Wrap Strips:

1. Biostop Pipe Collars; Bio Fireshield, Inc.;

2. WRS Wrap Strip; Nelson Firestop Products;
3. Metacaulk Wrap Strip; The RectorSeal Corporation;
4. SSW-12 Wrap Strips; Specified Technologies,Inc.;
5. 3M FS 195+ Wrap Strips; 3M Company, Construction Markets Division;
6. Tremco Wrap Strips; Tremco, Inc.; Cleveland,OH.

G. Job-Mixed Vinyl Compound:
1. USG Firecode Compound, United States Gypsum Co.; Chicago, IL.

H. Mortar:
1. K-2 Firestop Mortar, Bio Fireshield, Inc.;
2. Novasit K-10 Firestop Mortar, Bio Fireshield, Inc.;
3. CMP Firestop Compound; Nelson Firestop Products;
4. SSM-228 Firestop Mortar; Specified Technologies, Inc.;
5. 3M Fire Barrier Mortar; 3M Company, Construction MarketsDivision;
6. Tremstop Mortar System; Tremco, Inc.; Cleveland, OH.

I. Pillows/Bags:
1. Firestop Pillows, Bio Fireshield, Inc.;
2. PLW Firestop Pillows; Nelson Firestop Products;
3. SSB Series Firestop Pillows; Specified Technologies, Inc.;
4. Tremstop Pillow System; Tremco, Inc.; Cleveland, OH.

J. Silicone Sealants:
1. BioTherm 100/200; Bio Fireshield, Inc.;
2. CLK Firestop Caulk; Nelson Firestop Products;
3. SSB Series Firestop Pillows; SpecifiedTechnologies, Inc.;
4. Pensil 300 Firestop Sealant, GE Silicones; Waterford, NY;
5. Metacaulk 835, The RectorSeal Corporation;
6. Metacaulk 880, The RectorSeal Corporation;
7. 3M Fire Barrier 2000, 2000+ and 2003; 3M Company, Construction Markets Division;
8. Fyre Sil and Fyre Sil/SL; Tremco, Inc.; Cleveland, OH.

2.02 MATERIALS

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "Design and Performance Requirements" Article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:
   a. Semirefractory fiber (mineral wool) insulation.
   b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated formboard.
   d. Joint fillers for joint sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

D. Fill Materials For Through-Penetration Firestop Systems

1. Endothermic, Latex Compound Sealant: Single-component,endothermic, latex formulation.
2. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
3. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
4. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.
5. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.
6. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
7. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
8. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant, nonsag grade. Unless otherwise shown on the Contract Drawings, firestop system shall use nonsag grade for both vertical and horizontal surfaces.

2.03 MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application shown on the Contract Drawings.

PART 3. EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications shown on the Contract Drawings.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not shown on the Contract Drawings as permanent components of firestop systems.

C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications shown on the Contract Drawings.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform; cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration shown on the Contract Drawings or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.05 FIELD QUALITY CONTROL

A. Inspecting agency employed and paid by Engineer may examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.

B. Inspecting agency will report observations promptly and in writing to Contractor and Engineer.

C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.06 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of issuance of Certificate of Final Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

SECTION 07270

FIRESTOPPING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

07270A01 Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition shown on the Contract Drawings.

Product Data

07270D01 Product data for each type of product specified.

07270D02 Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.

07270D03 Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer's fire protection engineer with modifications marked.

Certificates

07270E01 Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.

07270E02 Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.

Manufacturer Test Reports

07270F01 Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on

comprehensive testing of current products.

Qualifications

07270K01 Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineers and Owners, and other information specified.

END OF APPENDIX "A"

DIVISION 7

SECTION 07272

SHEET AIR BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes self-adhering vapor retarding, modified bituminous sheet air barriers.

B. Related Sections include the following:
1. Division 4 Masonry Sections.
2. Division 5 Metals Sections.
3. Division 7 Thermal and Moisture Protection Sections.

1.02 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.03 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air Barrier Assembly Air Leakage: Not to exceed 0.02 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E 283.

1.04 SUBMITTALS

A. For submittals requirements – see Appendix "A" to this Section.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Contract, whose work has resulted in

applications with a record of successful in-service performance and that is an Air Barrier Association of America (ABAA) licensed contractor, employs certified and registered applicators, and complies with ABAA's Quality Assurance Program.

B. Applicator shall be certified or approved by the Manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

B. WARRANTY

1. Air barrier manufacturer's material and installation warranty for air barrier for a period of ten (10) years from date of issuance of Certificate of Final Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side and formulated for application of primer.

1. Products: Subject to compliance with requirements, furnish and install one of the following, or approved equal:

a. Carlisle Coatings & Waterproofing; CCW-705.
b. Grace, W. R. & Co.; Perm-A-Barrier.
c. Henry Company; Blueskin SA.
d. Meadows, W. R., Inc.; SealTight Air-Shield.
e. Tremco, Incorporated; ExoAir 110

2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft pressure difference; ASTM E 2178.
b. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.
c. Ultimate Elongation: 200 percent minimum; ASTM D 412, Die C, modified.
d. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
f. Puncture Resistance: 40 lbf minimum; ASTM E 154.
g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.02 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for use and compatible with air barrier.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.

D. Modified Bituminous Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

E. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

K. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil- thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

L. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 7 Section "Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with applicator present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrate is flush and joints have been completely filled to achieve a flush surface acceptable to the sheet air barrier manufacturer.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove any projections, pockets, holes, and other voids and uneven substrate surface irregularities with substrate patching material acceptable to the sheet air barrier manufacturer.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Tape joints with joint reinforcing strip. Apply a layer of self-adhering air barrier membrane over joint reinforcing strip.

3.04 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

2. Install strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same work period. Re-prime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials as indicated.

D. At end of each work period, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, modified bituminous counterflashing strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.05 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same work period. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.

E. Do not cover air barrier until it has been inspected and accepted by the Engineer.

F. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.06 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions and Division 1.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 60 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

DIVISION 7

SECTION 07272

SHEET AIR BARRIERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

   1. Include details of interfaces with other materials that form part of air barrier.

C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

D. Qualification Data: For Applicator.

E. Applicator Testing Data: Submit results of required testing - E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

END OF APPENDIX "A"

DIVISION 7

SECTION 07410

PREFORMED ROOF PANELS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for preformed roof panels structurally capable of spanning between supports or supported directly by a solid substrate and related flashings and accessory components as shown on the Contract Drawings.

B. Structural framing network or substrate surface support is specified in other Sections of these Specifications.

C. Roof Insulation.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A463	Specification for Steel Sheet, Aluminum-Coated by the Hot-Dip Process
ASTM A653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792	Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C920	Specification for Elastomeric Joint Sealants
ASTM C1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D523	Test Method for Specular Gloss
ASTM D1970	Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials used as Steep Underlayment for Ice Dam Protection
ASTM D4214	Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E331	Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E699	Practice for Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E-6
ASTM E1592	Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Air Pressure Difference
ASTM E1646	Test Method for Water Penetration of Exterior Metal Roof Panel Systems

by Uniform Static Air Pressure Difference

ASTM E1680 Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems

Steel Structures Painting Council (SSPC)

SSPC-Paint 12 Cold-Applied Asphaltic Mastic (Extra Thick Film)

Underwriters Laboratory (UL)

UL 580 Tests for Uplift Resistance of Roof Assemblies

UL Roofing Materials and Systems Directory

Sheet Metal and Air Conditioning Contractors National Association, Inc.(SMACNA)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.

B. Architectural Preformed Roof Panels:

1. Air Infiltration: ASTM E283 Air Infiltration: Maximum of 0;003 CFM./Ft2 at 10 psf pressure differential on 180 degrees seamed profile and 0.006 CFM./Ft2 at 20 pst pressure differential.

2. Water Penetration: ASTM E331 Water Penetration: No evidence of uncontrolled leakage on 180 degrees seamed panel at 20psf pressure differential.

C. Structural Preformed Roof Panels:

1. Air Infiltration: ASTM E283 Air Infiltration: Maximum of 0.006 CFM/Ft2 at 1.57 psf pressure differential on 45 degree seamed profile and 0.013 CRM/Ft2 at 6.24 psf pressure differential.

2. Water Penetration: ASTM E331 Water Penetration: No evidence of uncontrolled leakage on 45 degree seamed panel at 15.10 psf pressure differential.

3. Panel shall have been tested and rated in accordance with ASTME1592 structural performance of sheet metal and roof and siding systems by uniform static pressure difference in 24 gauge steel and .040" aluminum.

4. Panel shall have been tested and rated in accordance with Factory Mutual Research Corporation's Class 4471 wind uplifting testing; minimum rating of FM I-90.

D. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of UL 580 for Class 90 wind-uplift resistance. Panels shall be tested in accordance with ASTM E1592 wind uplift criteria

E. Air Leakage: ASTME1680 standard method for rate of air leakage through exterior metal roof panel systems.

F. Static Air Pressure: ASTME1646 standard test method for water penetration of metal roof systems by uniform static air pressure differential.

G. Structural Performance: Provide manufactured roof panel assemblies capable of safely supporting design loads indicated under in service conditions with vertical deflection no greater than L/240 based on testing manufacturer's standard units according to ASTM E1592 by a qualified independent testing and inspecting agency.

H. Factory-fabricate and finish panels and accessories by following the manufacturer's standard procedures and processes. Fabricate to profiles and dimensions shown on the Contract Drawings.

I. Panel shall display a flame spread classification of a (Class 1) when tested in accordance with ASTM E84.

J. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

1.04 QUALITY ASSURANCE

A. Provide Class 90 wind-uplift rated metal roof panel systems, as listed in "Roof Deck Constructions" chapter of UL Roofing Materials and Systems Directory. Panels shall bear the UL Classification Marking.

B. Field Measurements

Where possible, prior to fabrication of prefabricated panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

C. Installer Qualifications: Engage an experienced installer with at least a minimum of five years experience in similar type of construction and documenting successful completion of contracts for projects similar in size, scope and products.

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the construction site is located and who is experienced in providing engineering services of the type required for Work of this Contract.

E. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E699.

1.05 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle panels and other manufactured products to prevent damage. Stack materials stored on the construction site under a weathertight covering. Store panels so that water that might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining. Inspect the panels upon arrival at the construction site. If wet, remove the moisture and restack and protect the panels until used.

1.06 SUSTAINABLE DESIGN REQUIRMENTS

A. Sustainable Design General Requirements

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. The post-industrial and/or post-consumer recycled content (by material cost) of all preformed roof panels used shall be documented in accordance with the Division 1 Sustainability Requirements.

2. The assembly in which the preformed roof panels were manufactured shall be in accordance with the material proximity section of Division 1 Sustainability Requirements.

3. Provide preformed roof panel with factory finish achieving an emissitivity rating of at least 0.9 when tested in accordance with ASTM E408.

1.07 SUBMITTALS

For submittal requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

1. Subject to compliance with requirements of this Section, provide one of the following preformed roof panel systems, or approved equal:

a. Englert, Inc. Perth Amboy, NJ.

2. Subject to compliance with requirements of this Section, provide one of the following Polyisocyanurate manufacturers, or approved equal:

a. Multi-Max FA-3, as manufactured by R-Max, Inc., Dallas, TX.

b. AC Foam II, as manufactured by Atlas Energy Products, Atlanta, GA.

c. ISO 95+ GL, as manufactured by Firestone Building Products, Indianapolis, IN.

2.02 MATERIALS

A. Aluminum sheet for painting/coating, where aluminum preformed roof panels are shown on the Contract Drawings, shall comply with ASTM B209; allow, temper and mill finish as recommended by the panel manufacturer.

1. Metal gauges

Thickness required for structural performances, but not less than the manufacturer's recommended minimums for applications shown on the Contract Drawings, and not less than .032 inches thick.

B. Steel for painting/coating, where steel preformed roof panels are shown on the Contract Drawings shall be Hot-dip zinc coated steel sheet, ASTM A653, G90 structural quality; aluminum-zinc alloy-coated, ASTM A792, Class A2-50; or Aluminum-Coated, ASTM A463, T1-40-surfaces treated for maximum coating performance.

1. Metal gauges

   Thickness required for structural performances, but not less than the manufacturer's recommended minimums for profiles and applications shown on the Contract Drawings, and not less than 24 gauge.

C. Synthetic Bitumen Underlayment

1. Grace Ice & Water Shield HT or approved equal

   a. A cold-applied, self-adhering membrane composed of a high density, cross laminated polyethylene film coated on one side with a layer of rubberized asphalt adhesive and an embossed, slip resistant top surface.

   b. Conform to ASTM D1970.

D. Metal Finish

1. General

   Apply coatings either before or after forming and fabricating panels, as required by coating process, and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed. Provide colors or color matches shown on the Contract Drawings or, if not otherwise shown as selected by the Engineer from the manufacturer's standard color chart.

2. Flourocarbon Coating

   Coating will comprise of a .8 to .9 mil full strength 70% Kynar 500 flurocarbon (Polyvinylidene PVF2) coating over a urethane primer of .2 to .3 mil on the finish side, with primer and a wash coat on the reverse, on steel with just a wash coat on aluminum. Face film thickness 1.0 mil +/- .2mil.

   a. Comply with minimum requirements of AAMA 2605.

   b. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D4214; and without fading in excess of 5 Hunter units.

E. Polyisocyanurate Insulation

1. A closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers. The panel shall be in compliance with FED. SPEC. NO. HH-I-1972.

   a. Conform to ASTM C1289, Type II, Class 1, Grade 2.

2. Engineer's approval of primary insulation products by manufactures other than those listed above will be based on compliance with requirements of this section. The burden of proof of compliance is on the contractor.

3. All primary insulation shall comply with the following:

   a. Max. flame spread – 25 (ASTM E84)

   b. Max. smoke developed – 165 (ASTM E84)

   c. Max. toxicity not to exceed that of wood.

F. Miscellaneous Materials

1. Fasteners

   Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

   a. Where steel preformed roof panels are shown on the Contract Drawings:

      Use stainless-steel fasteners for exterior applications and galvanized steel fasteners for interior applications.

   b. Where aluminum preformed roof panels are shown on the Contract Drawings:

      Use aluminum or stainless-steel fasteners for exterior applications and aluminum or galvanized steel fasteners for interior applications.

   c. Provide exposed fasteners with heads matching color of panel by means of plastic caps or factory-applied coating.

   d. Provide metal-backed neoprene washers under heads of exposed fasteners bearing on weather side of panels.

   e. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

2. Accessories

   Provide components required for a complete roofing system, including internal panel framing, trim, copings, fascias, gravel stops, corner units, ridge closures, clips, seams covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match materials/finishes of preformed panels.

   a. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam flexible closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.

   b. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

   c. Elastomeric Joint Sealant: ASTM C920, of base polymer, type, grade, class, and use classifications required to seal joints in panel roofing and remain weather tight. Provide sealant recommended by panel manufacturer.

3. Bituminous Coating

Cold-applied asphalt mastic, SSPC paint 12, compounded for 15 mil dry film thickness per coat.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Comply with panel fabricator's and material manufacturer's installation instructions and recommendations, as applicable to conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal/structural movement. Install panels with concealed fasteners wherever possible.

B. Installation Tolerances

Shim and align panel units within installed tolerance of 1/4 inch in 20 feet-0 inches on level/plumb/slope and location/ line as shown on Contract Drawings, and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

C. Joint Sealers

Install gaskets, joint fillers and sealants where shown on the Contract Drawings and where required for weatherproof performance of panel systems. Provide types of gaskets and sealants/fillers shown on the Contract Drawings or, if not otherwise shown, types recommended by panel manufacturer.

D. Install felt underlayment and building-paper slop sheet on roof deck under metal panels, unless otherwise recommended by panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal panels. Apply from eave to ridge in shingle fashion and lap joints a minimum of 2 inches.

E. Coat backside of metal panels with bituminous coating where it will contact wood, ferrous metal, or cementitious construction.

3.02 ADJUSTMENTS

A. Damaged Units

Replace panels and other components of the Work which have been damaged or have deteriorated beyond successful repair by means of similar minor repair procedures.

B. Cleaning

Remove temporary protective coverings and strippable films (if any) as each panel is installed. Upon completion of installation, clean finished surfaces as recommended by the panel manufacturer, and maintain in a clean condition.

END OF SECTION

APPENDIX "A'

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials, and finished for each component and for total system of preformed panels.

B. Samples

Two 12 inch square samples, of each exposed finish material.

C. Color chart of the manufacturer's standard colors for color selection by the Engineer, when color is not shown on the Contract Drawings.

D. Shop Drawings

Small-scale layouts of roof panels and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim flashings, closures, and special details. Distinguish between factory and field assembly.

E. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Product Test Reports: Indicate compliance of manufactured roof panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.

H. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).

2) The assembling location of the supplied product(s)
3) The location (source) of the raw materials used to manufacture the supplied product(s).
4) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.

2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.
4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products *include, but are not limited to field-applied adhesives, sealants, carpets, paints and* coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).
5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 7

SECTION 07418

PREFORMED WALL PANELS - ALUMINUM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for insulated composite preformed aluminum wall panels structurally capable of spanning between supports and related flashings and accessory components.

B. Structural framing network or substrate surface support is specified in other Sections.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM B209	Aluminum and Aluminum - Alloy Sheet and Plate
ASTM C36	Gypsum Wallboard
ASTM C236	Test Method For Steady - State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C423	Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverbreation Room Method
ASTM C442	Gypsum Backing Board and Coreboard
ASTM C578	Specification for Rigid Cellular Polystyrene Thermal Insulation.
ASTM C591	Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C665	Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C991	Specification for Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings
ASTM D523	Test Method for Specular Gloss
ASTM D659	Method for Evaluating Degree of Chalking of Exterior Paints
ASTM D2244	Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM E72	Method for Conducting Strength Tests of Panels for Building Construction
ASTM E413	Classification for Determination of Sound Transmission Class

Architectural Aluminum Manufacturers Association (AAMA)

Standard Test TM-1 Specification for Method of Test for Metal Curtain Walls for Water Penetration Using Dynamic Pressure

Steel Structures Painting Council (SSPC)

Volume 2 "Systems and Specifications", SSPC-Paint 12 Cold-Applied Asphaltic Mastic (Extra Thick Film)

Underwriters Laboratory (UL)

Fire Resistance Directory

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Test preformed metal panel systems in accordance with 1.04 A.1 of this Section. Preformed metal panel system shall withstand inward and outward wall loading shown on the Contract Drawings with a maximum deflection of L/180.

B. Test wall panels in accordance with 1.04 A.2 of this Section. Provide the following required performances:

1. Water penetration

   No significant, uncontrolled leakage at 12 lbs. per sq. ft. pressure with spray test.

2. Air infiltration

   0.02 cfm per sq. ft. for gross wall areas, with 4 lbs. per sq. ft. differential.

C. Test STC sound transmission ratings and NRC noise reduction coefficient shown on the Contract Drawings, if any, in accordance with 1.04 A.3 of this Section. Where noise reduction requirement is shown on the Contract Drawings, provide perforated interior liner panel, cover insulation with polyethylene film and provide wire mesh inserts to form acoustical spacer grid.

D. Provide assembly listed in 1.04 A.5 of this Section for fire resistance rating shown on Contract Drawings, if any.

E. Factory-fabricate and finish panels and accessories by manufacturer's standard procedures and processes. Fabricate to profiles and dimensions shown on the Contract Drawings.

F. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

1.04 QUALITY ASSURANCE

A. Performance Test Standards

Where shown on the Contract Drawings provide preformed panel systems which have been pretested and certified by the manufacturer for the following:

1. Structural Deflection: ASTM E72
2. Water Penetration and Air Infiltration: AAMA Standard Test TM-1
3. Sound Transmission Coefficient (STC): ASTM E413
4. Noise Reduction Coefficient (NRC): ASTM C423

5. Fire Resistance Rating: UL Fire Resistance Directory

6. Thermal Performance: ASTM C236

B. Field Measurements

Where possible, prior to fabrication of prefabricated panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

1.05 WARRANTY

A. Furnish panel manufacturer's written warranty covering failure of the factory-applied exterior finish on metal wall panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Authority may have against the Contractor under the Contract Documents.

B. Failure shall include, but not be limited to:

1. Chalking of the fluorocarbon finish system to a degree greater than the maximum rating number of eight in accordance with procedures as outlined in ASTM D659,

2. Fluorocarbon finish will not change color more than the maximum number of NBS units of five as determined in accordance with the procedures set forth in ASTM D2244.

3. Any visible distortion or oil-canning of panels.

4. Film of the fluorocarbon finish will not blister, peel, chip, check, or crack under normal wear and tear.

5. Any other defects, including failure of sealants and fasteners, which would lessen the service life of the panel system.

C. Warranty period for factory-applied exterior finishes on wall and panels is 20 years after the date of Substantial Completion.

1.06 SUSTAINABLE DESIGN REQUIRMENTS

A. Sustainable Design General Requirements

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. The post-industrial and/or post-consumer recycled content (by material cost) of all preformed aluminum wall panels used shall be documented in accordance with the Sustainable Design Submittal Requirements of this Section.

2. The assembly in which the preformed aluminum wall panels were manufactured shall be in accordance with the material proximity section of Division 1 Sustainablility Requirements.

1.07 SUBMITTALS

For submittal requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide preformed siding products by one of the following, or an approved equal:

Englert, Inc. Perth Amboy, NJ.

2.02 MATERIALS

A. Aluminum Sheets

Shall conform to ASTM B209 and be alloy, temper and mill finish as recommended by the panel manufacturer.

1. Metal Gauges

Thickness required for structural performances, but not less than manufacturer's recommended minimums for profiles and applications as shown on the Contract Drawings, and not less than 0.040 inches for exterior panels and 0.032 inches for interior liner panels.

B. Metal Finish

1. General

a. Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability.

b. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed.

c. Provide colors or color matches as shown on the Contract Drawings or, if not otherwise shown, as selected by the Engineer from the manufacturer's standard colors.

2. Flouropolymer Coating

For exposed exterior surfaces, full-strength 70 percent "Kynar 500" coating baked-on for 15 minutes at 450 degrees F, in a dry film thickness of 1.0 mil, 30 percent reflective gloss conforming to ASTM D523, over min. 0.2 mil baked-on modified epoxy primer.

a. Complies with minimum requirements of AAMA 2605.

b. Coating shall have been field tested under weathering conditions for a minimum of 20 years without chalking in excess of photographic reference standard 8 of ASTM D4214.

3. Acrylic Enamel Coating

For exposed interior liner surfaces, factory-applied baked-on enamel coating, consisting of epoxy primer and acrylic enamel topcoat with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

4. Concealed surfaces shall receive one coat of the same primer as that specified for exposed surfaces.

C. Miscellaneous Materials

1. Fasteners

Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

a. Use aluminum or stainless steel fasteners.

b. Provide exposed fasteners with heads matching color of wall panel by means of factory-applied coating.

c. Provide metal-backed neoprene washers under heads of exposed fasteners bearing on weather side of panels.

d. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

2. Accessories

Except as indicated elsewhere in this Section as Work of another Section, provide components required for a complete preformed wall panel system, including internal panel framing, trim, copings, fascias, gravel stops, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashings, louvers, sealants, gaskets, fillers, closure strips and similar items. Match materials/finishes of preformed panels.

a. Closure Strips

Closed-cell, self-extinguishing, expanded cellular rubber or cross-linked polyolefin foam flexible closure strips. Cut or premold to match configuration of wall panels. Provide closure strips where indicated or necessary to ensure weathertight construction.

b. Sealing Tape

Pressure-sensitive 100 percent solids polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

c. Joint Sealant

One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the panel manufacturer.

3. Gypsum Board

Where required for fire rating, Type X fire rated, UL labeled board, complying with ASTM C442 or ASTM C36.

4. Bituminous Coating

Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil dry film thickness per coat.

2.03 FABRICATION

A. General

Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as required to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and dimensional requirements and with structural requirements.

B. Sound Control

Where sound absorption requirement is shown on the Contract Drawings, indicated, fabricate interior liner panels with approximately 1000 uniformly spaced 1/8-inch-diameter holes per sq. ft. Cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

C. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finishes.

D. Wall Panels

1. Face Sheets

Fabricate wall panel face sheets to the profile or configuration indicated from 0.040-inch aluminum sheets.

2. Where shown on the Contract Drawings, provide one of the following wall panel system.

a. Field-assembled wall panel units consisting of an insulating material between metal interior and exterior face sheets. Securely fasten units together with rivets, bolts, studs, or other approved methods of fastening, including interlocking with basic wall units.

b. Factory-assembled wall panel units consisting of a specified core material liquid foamed-in-place between the metal interior and exterior face sheets.

E. Secondary Framing

1. Wall Girts

"C"- or "Z"-shaped sections fabricated from 0.0598-inch (16-gauge) galvanized, roll-formed steel.

2. Flange and Sag Bracing

1-5/8- by 1-5/8-inch angles fabricated from roll-formed stainless steel or aluminum.

3. Base or Sill Angles

Cold-formed stainless steel or aluminum sections.

4. Secondary structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from 0.0747-inch (14-gauge) cold-formed galvanized steel.

PART 3: EXECUTION

3.01 INSTALLATION

A. General

Comply with panel fabricator's and material manufacturer's instructions and recommendations for installation, as applicable to conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal/structural movement. Install panels with concealed fasteners.

B. Panel Supports and Anchorage

Girts, angles, and other secondary structural panel support members and anchorage shall be installed in accordance with AISC Manual of Steel Construction "Code of Standard Practice."

C. Installation Tolerances

Shim and align panel units within installed tolerance of 1/4 inch in 20 feet - 0 inches on level/plumb/slope and location/line as shown on the Contract Drawings, and within 1/16 inch offset of adjoining faces and of alignment of matching profiles.

D. Joint Sealers

Install gaskets, joint fillers and sealants where shown on the Contract Drawings and where required for weatherproof performance of panel systems. Provide types of gaskets and sealants/fillers as specified in this Section or, if not otherwise shown, use types recommended by panel manufacturer.

E. Wall Panels

Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.

1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
4. Field cutting of exterior panels by torch is not permitted.

F. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous coating or other permanent separation. Allow bituminous coating to dry prior to installation of component.

3.02 ADJUSTMENTS

A. Damaged Units

1. The Engineer will make the final determination on the replacement or repair of damaged units.
2. Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair. Repairs shall be made by means of finish touch-up or similar minor repair procedures.

B. Cleaning

Remove temporary protective coverings and strippable films (if any) as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended by the panel manufacturer, and maintain in a clean condition.

END OF SECTION

SECTION 07418

PREFORMED WALL PANELS - ALUMINUM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.

B. Samples

Submit two, 12-inch square samples of each exposed finish material.

C. Shop Drawings

Small-scale layouts of panels on walls and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim flashings, closures, and special details. Clearly indicate which items are factory assembled and field assembly.

D. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein.

Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).
      2) The assembling location of the supplied product(s)
      3) The location (source) of the raw materials used to manufacture the supplied product(s).
      4) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.
2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.

4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).

5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 7

SECTION 07567

TWO-PLY SEBS MODIFIED BITUMEN ROOFING SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for a two-ply SEBS (Styrene-Ethylene-Butadiene-Styrene) modified bitumen roofing system.

B. As used herein, "roofing system" shall be defined as materials furnished and installed as Work of this Section, including but not limited to:

Roofing membranes, vapor seals, separation sheets, flashing, reglets, fasteners, wood blocking, cants, pitch pockets, insulation, form (cover) board, insulation (including tapered) cold adhesives, encapsulants, miscellaneous metal Work required for roofing, clips, brackets, etc. and all other roofing appurtenances.

C. Items of Work which are part of the "roof system" but specified in other Sections of the Specifications include the following:

1. Metal cap flashing and gravel stops (Division 7).
2. Not Used
3. Prefabricated curb units (Division 7).

D. Related Work specified in other Sections of the Specifications include the following:

1. Roof drains (Division 15).

1.02 REFERENCES

The following is a listing of publications referenced in this Section.

<u>American Society of Civil Engineers (ASCE)</u>

ASCE 7-05 Minimum Design Loads for Buildings and Other Structures.

<u>American Society for Testing and Materials (ASTM)</u>

ASTM A526 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Commercial Quality

ASTM C518 Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties

ASTM C552 Specification for Cellular Glass Block and Pipe Thermal

ASTM C711	Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric Solvent-Release Type Sealants
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear
ASTM D5	Test Method for Penetration of Bituminous Materials
ASTM D41	Standard Specification for one Asphalt Primer used in Roofing and Waterproofing
ASTM D92	Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D93	Test Method for Flash and Fire Points by Pensky-Martens Closed Tester
ASTM D146	Methods of Sampling and Testing Bitumen-Saturated Felts and Fabrics Used in Roofing and Waterproofing.
ASTM D312	Standard Specification for Asphalt Used In Roofing
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D1079	Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials
ASTM D1227	Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D1622	Test Method for Apparent Dry Density of Rigid Cellular Plastic
ASTM D1850	Specifications for Concrete Joint Sealer, Cold Application
ASTM D2178	Standard Specification for Asphalt Glass Felt Used as a Protective Coating for Roofing
ASTM D2196	Standard Test Method for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer
ASTM D2822	Standard Specification for Asphalt Roof Cement
ASTM D2823	Standard Specification for Asphalt Roof Coatings
ASTM D2898	Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D4601	Standard Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.

ASTM D6152	Standard Specification for SEBS-Modified Mopping Asphalt used in Roofing.
ASTM D6162	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D6511	Standard Test Methods for Solvent Bearing Bituminous Compounds
ASTM E84	Method for Surface Burning Characteristics of Building Materials
ASTM E108	Standard Test Methods for Fire Test of Roof Coverings.
ASTM E408	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

FM Global (FM)

1-28	Property Loss Prevention Data Sheet - Wind Design.
1-29	Property Loss Prevention Data Sheet – Roof Deck Securement and Above – Deck Roof Components.
Class Number 4470Approval Guide	Approval Standard for Single-Ply, Polymer-Modified Bitmen Sheet, Built-up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.

General Services Administration, Washington, DC (FED. SPEC.)

HH-I-1972	Composite Plastic Panels
SS-A-00694c	Asphalt Roof Coatings
SS-C-153	Asphalt Roof Cement
SS-S-1596b	Rubber Properties

United States Product Standard (PS)

PS 20	American Softwood Lumber Standard

Underwriters' Laboratories, Inc. (UL)

UL RMSD	Roofing Materials and Systems Directory

United States Environmental Protection Agency (USEPA)

National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M

600/R-93-116 Asbestos in Bulk Building Materials

US Environmental Protection Agency ENERGY STAR® Program

EPA Energy Star Roofing Guidelines

United States Department of Labor (USDOL)

Material Safety Data Sheets

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Roof system shall conform to the following:

1. UL Listing

   a. Provide labeled materials which have been tested and listed in UL "Roofing Materials and Systems Directory" as "Class A" where roof slopes are less than 1/2 inch per foot and "Class B" where roof slopes are greater than 1/2 inch per foot.

2. Wind Uplift Resistance

   a. Follow recommendations of FM Data Sheet 1-28 and the FM Approval Guide. System shall comply with FM class 1-90 rating.

   b. At perimeter, install 1.5 times and at corners install two times as many fasteners as required by the manufacturer for the roof field.

   c. Wind Uplift Calculations

      Provide uplift calculations signed and sealed by a Professional Engineer licensed in the state where the work is performed validating the wind uplift resistance per ASCE 7.

3. Hail Resistance Rating: FM Class I-SH.

B. Where the Contract Drawings show roof insulation of thickness greater than those listed in the FM Approval Guide for 1-90 rating, or if insulation of greater thickness is required for proper drainage, conform to requirements of the Approval Guide and this Section and provide one fastener per square foot at all affected areas.

C. Mechanical fasteners or fully adhered adhesive.

   Conform to requirements of paragraph 4.3 of FM Approval Standard 4470.

D. Insulation

   Provide thermal resistance aged R-value shown on the Contract Drawings when tested in accordance with ASTM C518.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Comply with approved roofing system manufacturer's recommendations as to environmental conditions under which roofing may be applied. Also, take into account the effect of wind velocity on the roof surfaces during Installation.

B. Comply with the USEPA "National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M".

C. Precipitation

Roofing materials shall not be applied during precipitation and shall not be applied in the event there is a probability of precipitation during application. The Contractor shall take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.

D. Ambient Temperatures - Cold Adhesive

At ambient temperatures of forty (40) degrees F or below, taking into account wind chill, cold adhesive shall be stored in a warm place immediately prior to use. Application shall be discontinued if cold adhesive cannot be kept at temperatures allowing for even distribution.

1.05 QUALITY ASSURANCE

A. The Contractor shall certify to the Engineer that the entity performing application is approved by the manufacturer of the roofing system, has a minimum of five years experience in the installation of systems involving quantities and complexities at least equal to those required for the Work of this Section, and is thoroughly familiar with the product. The system shall be installed in strict compliance with the manufacturer's requirements.

B. Pre-Installation Meeting

1. Prior to installation of the roofing system, but after all required submittals have been received including schedule for performing the Work, a meeting shall be held at the construction site at a time agreed to by the Engineer and Contractor.
2. The roofing job superintendent, the roofing foreman and a representative of the roofing applicator and manufacturer shall be present at the meeting.
3. The Engineer will also be present to examine the details of all components of the proposed roofing system for compliance with requirements of this Section.
4. All questions regarding materials, construction details, scheduling and installation shall be resolved at this meeting with the Engineer.

C. Job Control

1. A qualified representative of the roofing manufacturer shall be available to make a minimum of three (3) site inspections per week during the course of the Work to ensure compliance with this specification Section. Manufacturer's representative shall be present for other portions to the roof installation Work where required by this Section.

2. The Engineer or his representative may make an inspection after application of each roof component as the Work progresses. Any portions of the roofing system that do not comply fully with all the requirements herein or that show any visible defects shall be immediately removed and replaced or corrected to the satisfaction of the Engineer and the roofing manufacturer. This inspection shall not represent a final acceptance of said components.

D. Final Inspection

1. Upon completion of all Work under this Section, and all related Work, a final inspection of the preformed membrane roofing system and appurtenances will be conducted by the Engineer and the manufacturer's representative.

2. Upon repair to the satisfaction of the Engineer of all defects revealed by such final inspection, furnishing of the Maintenance Instructions and the Guarantees required by this Section and completion of all other Work required by the Contract, a Certificate of Final Completion will be issued as deemed appropriate by the Engineer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver material in the manufacturer's original, unopened containers and rolls with labels intact and legible.

B. Deliver material requiring fire resistance classification to the construction site with labels attached and packaged as required by labeling service.

C. Deliver materials in sufficient quantity to allow continuity of work.

D. Handle rolled goods so as to prevent damage to edge or ends.

E. Select and operate material handling equipment so as not to damage existing construction or installed roofing.

F. Store all materials on clean raised platforms.

G. Provide continuous protective covering for those materials which require protection against wetting, moisture absorption and direct sunlight.

H. Protect materials against damage by construction traffic.

I. Remove damaged materials from the construction site and away from Authority property.

J. Conform to the manufacturer's recommendations for handling and storage of materials.

1.07 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. The post-industrial and/or post-consumer recycled content (by material cost) of all roofing material used shall be documented in accordance with the Division 1 Sustainability Requirements.
2. The assembly which the roofing components were manufactured shall be in accordance with the material proximity section of Division 1 Sustainability Requirements.
3. The ENERGY STAR® compliant and "high emissivity" roofing components shall be documented in accordance with the Sustainable Design Submittal Requirements of this Section.

1.08 SUBMITTALS

A. See Appendix "A" for submittal requirements.

1.09 GUARANTEE

A. As a condition precedent for the start of Work of this Section, the Authority shall require submission of written approval of the Guarantees provided in Appendices "B" and "C" to this Section by both the Contractor and the Manufacturer. Written approval shall indicate total compliance, without exception or amendment, with all provisions of the Guarantees.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with all requirements of this Section, provide systems of one of the following manufacturers:

1. Mineral Granular SEBS Roof System (as noted on the Contract Drawings)

   a. Dynamax Smooth, DynaMax FR, TopGard Base and TopGard 5000 by Johns Manville, Denver, Colorado 80202, (303) 978-2000.
   b. StressBase 120, STRESSPLY Plus EB FR Mineral and Pyramic Coating by The Garland Company, Cleveland, OH 44105 (216) 641-7500.
   c. PowerPly HT, PowerPly HT FR, Ice Coating by Tremco, Beachwood, OH 44122 (216) 292-5000.

B. There shall be no substitutions of the specified system type.

C. Listed below is the "Table of Approved Materials", of Johns Manville, Garland, and Tremco specified products and the equivalent materials indicated in this Section.

TABLE OF APPROVED MATERIALS

JOHNS MANVILLE

Asphalt Primer	JM Asphalt Primer
Base Ply	Dynamax Smooth
Mineral Cap Sheet	DynaMax FR
Cold Applied Adhesive	MBR Cold Application Adhesive
Roof Coating	TopGard Base & TopGard 5000
Pitch Pocket Sealer	Approved Pourable Sealer
Liquid Applied Flashing	PermaFlash
2 pc Counterflashing	Approved Stainless Steel Counterflashing
Counterflashing	Approved Stainless Steel Counterflashing
PolyU 1 Part Caulk (horiz)	Approved Sealant
Standard Reglet Caulk	Approved Reglet Caulk
Walkway Pads	JM DynaTred
Form (Cover) Board	Approved Form (Cover) Board
Steel Deck Fasteners	Ultra Fast Fasteners
Spot Adhesive	2 Part Urethane Insulation Adhesive

TABLE OF APPROVED MATERIALS

GARLAND

Asphalt Primer	Garla-Prime
Base Ply	StressBase 120
Mineral Cap Sheet	StressPly Plus EB FR Mineral
Cold Applied Adhesive	Weatherking
Roof Coating	Pyramic
Pitch Pocket Sealer	SealTite
Liquid Applied Flashing	Tuff-Flash
Cold Roof Spot Cement	Flashing Bond
2 pc Counter flashing	Approved Stainless Steel Counterflashing
Counter Flashing	Approved Stainless Steel Counterflashing
PolyU 1 Part caulk (horiz)	Tough Stuff
Standard Reglet Caulk	Tough Stuff
Walkway Pads	Approved Walkway Pads.
Form (Cover) Board	Approved Form (Cover) Board
Steel deck fasteners	Approved Fasteners
Spot Adhesive	Insulock HR

TABLE OF APPROVED MATERIALS

TREMCO

Asphalt Primer	TremPrime QD
Base Ply	PowerPly HT
Mineral Cap Sheet	PowerPly Plus HT FR
Cold Applied Adhesive	PowerPly Standard Cold Adhesive
Roof Coating	Ice Coating
Pitch Pocket Sealer	2 Component Urethane Pitch Pocket Sealer
Liquid Applied Flashing	Alpha Guard
Cold Roof Spot Cement	ELS
2 pc Counterflashing	Approved Stainless Steel Counterflashing
Counterflashing	Approved Stainless Steel Counterflashing
PolyU 1 Part caulk (horiz)	Approved Sealant
Standard Reglet Caulk	TremSeal D
Walkway Pads	TremTred
Form (Cover) Board	Approved Form (Cover) Board
Steel Deck Fasteners	Approved Fastener
Spot Adhesive	Tremco Low Rise Foam Adhesive

2.02 MATERIALS AND ACCESSORIES

A. The roofing system shall be a fully adhered, two-ply preformed membrane roofing system, or as otherwise shown on the Contract Drawings, including but not limited to the following components, as required by the roofing manufacturer and as specified in this Section:

1.	Form (cover) board:	Dens Deck or approved equal.
2.	Insulation:	Primary, tapered and fill.
3.	Base Sheet:	Minimum Type II, Grade S and shall meet or exceed the criteria of ASTM D6162.
4.	Cap Sheet:	Minimum Type III, Grade G and shall meet or exceed the criteria of ASTM D6162.
5.	Roof Membrane Flashing:	Two ply modified bitumen flashing unless otherwise shown on the Contract Drawings.
6.	Roof Coating:	As approved by manufacturer for the type of roofing membrane as shown on the Contract Drawings.
7.	Metal Flashings:	Stainless steel
8.	Reglets / Termination Bars:	Stainless steel
9.	Fasteners/Adhesive:	As approved by manufacturer for type of deck as shown on the Contract Drawings.
10.	Walkway pads:	As required by the manufacturer of the roofing membrane or as shown on the Contract Drawings.

11. Treated wood nailers, treated wood blocking or treated wood cants.
12. Roof expansion joints, where shown on the Contract Drawings.
13. Fascias, gravel stops, cleats and fascia fasteners.
14. Additional materials and accessories, including but not limited to coatings, solvents, sealants, adhesives and other elements required for a complete membrane roofing system.

B. Roofing Membrane Assembly

The roofing membrane assembly shall consist of one (1) ply of prefabricated polyester/ fiberglass composite reinforced, homogeneous Styrene-Ethylene-Butadiene-Styrene (SEBS) or Styrene-Butadiene-Styrene (SBS) copolymer modified base membrane and one (1) ply of prefabricated polyester/fiberglass composite reinforced, homogeneous Styrene-Ethylene-Butadiene-Styrene (SEBS) copolymer modified cap membrane secured to a prepared substrate.

The modified base membrane shall be fully adhered to the prepared substrate as specified herein, and shall possess waterproofing capability, such that a phased roof application, with only the modified base membrane in place, can be achieved without detriment to the watertight integrity of the entire roof system. The modified bitumen cap membrane shall be fully adhered to the modified base membrane as specified herein. Each membrane of the roof assembly shall meet the following physical requirements as a minimum.

1. Modified Bitumen Base Ply Membrane: (DynaMax Smooth, StressBase 120, PowerPly HT)

a.	Thickness:	80 mils (2.032 mm)
b.	Reinforcement:	Polyester/Fiberglass Composite
c.	Elongation @ 0°F:	MD/XMD: 2%
d.	Tensile Strength @ 0°F:	MD/XMD: 100 LBF/IN
e.	Grab Tensile @ 0°F:	MD/XMD: 125 LBF/IN

2. Modified Bitumen Cap Sheet Membrane (Mineral Granular Finish): (DynaMax FR, StressPly Plus EB FR Mineral, PowerPly Plus HT FR)

a.	Thickness:	135 mils (3.5 mm): ASTM D751
b.	Reinforcement:	Polyester/fiberglass composite
c.	Elongation @ 0°F:	MD/XMD: 2%
d.	Tensile Strength @ 0°F:	MD/XMD 250 LBF/IN
e.	Grab Tensile @ 0°F:	MD/XMD: 250 LBF/IN.

C. Flashing Membrane Assembly

1. Unless otherwise shown on the Contract Drawings, flashing membrane assembly shall consist of two plies identical to those specified in 2.02 B.1 and B.2 of this Section for base ply and cap sheet.

D. Roofing Adhesives

1. Cold Adhesive

a. Cold Adhesive shall be utilized as recommended by the roofing system manufacturer where roofing slopes are greater than 1/2" but not greater than 2 1/2 inches per foot or where limited by the manufacturer. The cold process adhesive shall consist of a high grade, asphalt solvent based cutback designed for high flash and quick drying. The adhesive shall be in full compliance with requirements contained within ASTMD2823, Type 1 and Fed. Spec. No. SS-A-00694c.

b. Conform to the following Performance Properties:

(1) Non-Volatile Content ASTM D4479 70%

(2) Density ASTM D1475 7.89 lbs./gal. (0.9kg/l)

(3) Viscosity Stormer ASTM D562 16-20 sec.

(4) Slope: up to 3:12

E. Bituminous Cutback Materials

1. Asphalt Primer

Asphalt primer shall consist of a high flash, quick drying, asphalt solvent blend conforming to ASTM D41.

a. Conform to the following Performance Properties:

(1)	Viscosity:	13-16 sec. ASTM D1200
(2)	Density:	7.5 - 8.0 lbs/gal ASTM D1475
(3)	Solids by Weight:	43-45% ASTM D1644

2. Mastics

a. Roof mastic shall consist of a high grade asphalt, solvent based cutback reinforced with treated non-asbestos fillers conforming to ASTM D2822 and Fed. Spec. No. SS-C-153, Type I.

b. Conform to the following Performance properties:

(1)	Asbestos Content:	0%
(2)	Solids by weight:	78-82% ASTM D4586
(3)	Viscosity @ 77°F:	450,000-950,000 CP ASTM D2196
(4)	Resistance to Sag:	1/8" Min. ASTM D4586

F. Pitch Pocket Filler:

1. If pitch pocket is new, shall consist of a two (2) component, cold applied urethane compound of pouring consistency meeting ASTM D1850 and Fed. Spec. No. SS-S-1596b.

2. If pitch pocket is re-used, shall consist of a one part elastic bitumastic pourable sealer.

G. Joint caulking shall consist of a single component, high performance, elastomeric sealant as manufactured by the following or approved equal:

1. Tremseal GP by Tremco, Cleveland, Ohio.
2. Sonolastic NP 1 by Sonneborn Building Products, Minneapolis, Minnesota.
3. KN-1 Caulk by Karnak,

H. Sealants shall be as approved by the manufacturer of the membrane roofing system. Caulking compounds, sealants and any other materials applied to or coming in contact with any component of the roofing system shall be installed in strict compliance with the published instructions of the manufacturer.

I. Top Sheet Granule Surfacing (If specified)

Mineral granules shall match the color scheme of the modified bitumen cap sheet as selected by the Engineer and shall be as manufactured by 3M Roofing Granules, No. 11 grade specification, or approved equal.

J. Roof Insulation

Primary roof insulation shall be UL and FM approved, and be accepted by the roofing membrane manufacturer. All roofing panels shall be sufficiently rigid to span the fluted openings of the metal roof deck, if applicable and shall be a minimum thickness of 1". A maximum panel size of four (4) feet by four (4) feet shall be maintained where insulation is specified to be installed in hot asphalt. The primary insulation shall be rigid type with a minimum aged "R" value of 8, minimum density of 2 pcf in accordance with ASTM D1622 and shall be one of the following as shown on the Contract Drawings and in accordance with this Section. Two Ply modified bitumen membrane system shall not be adhered directly to Polyisocyanurate insulation. A separate top layer of approved form (cover) board shall be used as the 2nd layer substrate.

1. Polyisocyanurate Board Insulation: Rigid , closed-cell cellular polyisocyanurate thermal insulation integrally laminated to heavy non-asphaltic fiber-reinforced felt facers core formed by using HCFCs as blowing agents to comply with ASTM C1289 Type II, Class 1, Grade 2; with minimum compressive strength of 20 psi, nominal 2.0 pcf density; and as follows:
   a. Facer Type: Felt or glass-fiber mat.
   b. Provide one of the following manufacturers/products, or approved equal:
      ISO 95+ GL, as manufactured by Firestone Building Products, Indianapolis, IN.
      AC Foam II, as manufactured by Atlas Energy Products, Atlanta, GA.
      Multi-Max FA-3, as manufactured by R-Max, Inc., Dallas, TX.

2. Engineer's approval of primary insulation products by manufacturers other than those listed above will be based on compliance with requirements of this Section. The burden of proof of compliance is on the Contractor.

3. All primary insulation shall comply with the following:
   a. Max. flame spread - 25 (ASTM E84)
   b. Max. smoke developed - 165 (ASTM E84)
   c. Max. toxicity not to exceed that of wood.

K. Tapered and fill insulation shall be used where shown on the Contract Drawings, and shall be inorganic board and shall be one of the following, as shown on the Contract Drawings or if not shown, in accordance with this Section. Tapered and fill insulation is applied over the primary insulation to provide the required slope and to pitch to roof drains.

1. Tapered Polyisocyanurate

a. Engineer's approval of tapered and fill insulation products by manufacturers other than those listed above will be based on compliance with requirements of this Section. The burden of proof of compliance is on the Contractor.

b. Tapered insulation board and fill boards shall be installed over the primary insulation herein specified with the minimum slope required to obtain adequate drainage as shown on the Contract Drawings. The Contractor shall submit tapered insulation board layout for approval by the Engineer.

c. Provide tapered insulation saddles between all roof drains. Saddles shall be of Tapered Polyisocyanurate insulation as specified in Section 2.02 J.

L. Form (cover) board shall be used where shown on the Contract Drawings and shall be inorganic board manufactured to meet ASTM C1177 and shall be one of the following;

1. Dens Deck Roof Board, as manufactured by Georgia Pacific, Atlanta, GA, or as shown on the Contract Drawings.

2. Or approved equal.

M. Fasteners

1. Base Sheet Fasteners

a. The base sheet fasteners used shall be FM approved and approved by the manufacturer of the primary roofing products. Acceptable manufacturers of base sheet fasteners for specific deck types as shown on the Contract Drawings and as listed below, shall comply with FM I-90.

b. The Contractor may submit similar and equal products of other manufactures to the Engineer for approval, with each submittal bearing the stamp and signature of approval of the roofing manufacturer.

(1) Wood Decks

a. Square Cap by W.H. Maze Co, Peru, IL.

b. 12 Gauge Simplex Nail by the Simplex Nail and Manufacturing Co., Americus, GA.

c. Or approved equal

(2) Plywood Decks

a. Square Cap by W.H. Maze Co, Peru, IL.

b. 12 Gauge Simplex Nail by the Simplex Nail and Manufacturing Co., Americus, GA.

c. Senco Staple-Tape Assembly. The assembly consists of 5/16 inch Rayon tape with 7/8 inch coated, divergent staples. Type N 12 as manufactured by Senco Fastening Systems, Cincinnati, OH.

(3) Lightweight Concrete Decks

a. Zonotite Base Ply Fastener or NVS Base Ply Fastener by W.R. Grace Company, Cambridge, MA.

(4) Wood Cement Fiber Decks

a. ES/Nail Base Ply Fastener by ES Products, Inc., New Rochelle, NY.

b. Tube-Loc Nail by Simplex Nail and Manufacturing Co., Americus, GA.

c. NTB Fastener by NTB, Inc., Mosines, WI.

(5) Gypsum Decks

a. ES/Nail Base Ply Fastener by ES Products, Inc., New Rochelle, NY.

b. Nail-Tite by ES Products, Inc., New Rochelle, NY.

c. Tube-Loc Nail by Simplex Nail and Manufacturing Co., Americus, GA.

2. Insulation Fasteners

a. Insulation mechanical fasteners shall be coated for corrosion resistance when subjected to 30 Kesternich cycles shows more than 1% red rust, conforming to FM 4470. Insulation fasteners shall be as supplied by the membrane manufacturer. Insulation fasteners shall be for specific deck types, as shown on the Contract Drawings, as follows:

(1) Metal Decks

a. Insul-R Fasteners by W. P. Hickman Systems, Inc.

b. Climaseal with Buildex Metal Plates, as manufactured by ITW Buildex, Itasca, IL.

c. #12 Standard Roofing Fastener, as manufactured by Olympic Fasteners, Agawam, MA.

(2) Wood Decks

a. Insul-R Fasteners by W.P. Hickman Systems.

b. Climaseal with Buildex Metal Plates as manufactured by TW Buildex, Itasca, IL.

c. #14 Standard Roofing Fastener, as manufactured by Olympic Fasteners, Agawam, MA.

(3) Plywood Decks

a. #14 Standard Roofing Fastener, as manufactured by Olympic Fasteners, Agawam, MA.

b. The Peel Rivet, TPR, as manufactured by Creative Construction Components, Inc., Elmira, NY.

c. Deckfast #14 with Deckfast Steel Hexagonal Plates, as manufactured by Construction Fasteners, Inc., Wyomissing, PA.

(4) Structural Concrete Decks

a. #14 Standard Roofing Fastener, as manufactured by Olympic Fasteners, Agawam, MA.

b. Insul R- Concrete Fasteners by W.. P. Hickman systems. Solon, OH.

c. Or approved equal.

(5) Gypsum Decks

a. Tube-Loc Nail, as manufactured by Simplex Nail and Manufacturing Co., Americus, GA.

b. NTB Fastener, as manufactured by NTB, Inc., Mosines, WI.

c. Gyptec Fasteners and Plates, as manufactured by ITW Buildex, Itasaca, IL.

b. Fasteners shall be approved by the manufacturer of the roofing system and the insulation for type, length, coating and pattern for conformance with 1.03A.2. and 1.03C herein.

N. NOT USED.

O. Wood Nailers, Wood Blocking, Wood Cants

PS 20 "Standard No. 2" lumber of species eligible for UL listing, where shown on the Contract Drawings or required by the membrane roofing system manufacturer. Fire retardant treatment shall conform to AWPA C 20, exterior type halogen and sulphate free, or equal treatment approved by the membrane roofing system sheet manufacturer, which shall:

1. Show no increase in fire hazard classification when tested in accordance with ASTM D2898, Method A;
2. Be sized so that no field rip cuts or milling is required after treatment only end cuts and hole drilling are permitted, and
3. Identify each piece "FR-S" with UL brand mark, or other testing agency, approved by the Engineer.

P. Fabricated Metals

All fabricated metal components incorporated into the roofing system shall be either twenty six (26) gauge minimum stainless steel Type 316 L; twenty four (24) gauge minimum, galvanized steel complying with ASTM A526, G90 coating designation; or .050" thick aluminum with baked enamel finish, as shown on the Contract Drawings.

1. Metal edge/fascia

a. Shall be prefabricated with stainless steel cant dam and fascia. The fascia shall be of sufficient width to completely cover the roof assembly-wall juncture, as recommended by the roofing membrane manufacturer. The bottom edge of the fascia shall have a minimum one-half (1/2) inch drip edge hemmed and formed at thirty (30) degrees. All metal Edge/Fascia assemblies shall be from the membrane manufacturer and to be included, as an endorsement on the membrane warranty.

b. Metal edge/fascia shall be fabricated in maximum lengths of ten (10) feet. Largest possible lengths shall be installed.

c. Corner pieces shall extend from the corner in both directions, for factory miters or corners a minimum of one (1) foot. Corners shall be sealed and/or fastened to ensure watertightness.

d. Terminations and ends shall be capped and sealed.

e. Hold-down cleats shall be continuous stainless steel.

f. Flashing Membrane shall be SEBS or SBS modified membrane as detailed on drawings.

g. All metal flashing, flashing membrane, adhesvies, sealants and reinforcing mesh shall be supplied by the system supplier issuing the warranty.

h. Metal pipe flashings shall consist of a two (2) component galvanized steel assembly.

(1) The lower base component shall be a synthetic rubber roof jack with a minimum four (4) inch perimeter flange and sleeve opening as required with a minimum of six (6) inch height.

(2) The upper component shall be a stainless steel water tight umbrella, fabricated to be mechanically secured around the roof penetration with a stainless steel strap clamp, and extend beyond the roof jack opening by a minimum radius of three (3) inches. The top edge of the umbrella shall be caulked with sealants as described in 2.02G.

i. Pitch pockets shall be fabricated with a minimum perimeter flange of four (4) inches. The top edges of the pocket will be hemmed. All seams shall be fastened welded. The pitch pocket shall be of sufficient height to extended upward minimum of two (2) inches above the roof surface.

j. Walkway pads shall consist of a traffic resistant polymer modified bitumen, polyester reinforced, and surfaced with mineral granules. Walkway pads shall be by the membrane manufacturer.

(1) Thickness: 8.00 mm ± .3mm (.315 in., ±.012 in.)
(2) Weight: 6.0 KG/M2 ± .3 KG/M2 (1.51 lb./in. 2 , ±.07 lb./in.2)

Q. Roof coating shall be water based elastomeric acrylic coating with high solids. Color shall be white. Specific pastel colors shall be supplied upon request of the owner. Coverage Rate shall be in conformance with that of roofing Manufacturer's requirements for mineral surfaces. Roof coating shall be ENERGY STAR® compliant and achieve an emissivity of at least .9 when tested in accordance with ASTM E408-71 for a minimum of 75% of the roof surface.

(1) Roof coating shall conform to the following performance properties:

a.	Asbestos Content:	0% EPA 600/M4- 82-020
b.	Elongation @ 72°F:	70% min ASTM D 412
c.	Reflectance:	87% MIN. ASTM D 97
d.	Tensile:	110 psi min. ASTM D 412
e.	Flash Point:	None ASTM D 93
f.	Flexibility:	-15°F., ASTM C 711
g.	Density @ 77°F:	11.6 lbs./gal ASTM D 1475
h.	Solids by Weigh:.	64% minimum ASTM D 1644

PART 3. EXECUTION

3.01 EXAMINATION

A. Examine surfaces for foreign material, moisture, ice, and unevenness or any other defects which would prevent the execution and quality of application of the membrane roofing system as specified and make all necessary corrections before beginning roof system installation Work.

3.02 PREPARATION

A. Supervision

1. The Contractor shall ensure that a representative of the manufacturer of the roofing system supervises the installation to assure proper installation of the roof; is present during field surveys for preparing Shop Drawings; is present at all construction meetings; is present as construction progresses; and is present at the final inspection.

B. Scheduling

1. Do not commence roofing unless all portions of the section of roof on which construction is commenced can be completed on that day. Phased construction will not be permitted.

C. Thoroughly clean surfaces to receive the membrane roofing system of all loose aggregate and excessive deposits of roof coating, dirt, oil, grease, water or other objectionable materials immediately prior to placing any roofing materials.

D. Removal and Reinstallation of Existing Roofing Items

1. Remove and reinstall all items as required for a complete roof installation and as otherwise shown on the Contract Drawings and approved shop drawings.

2. NOT USED.

E. Perform other surface preparation as required by the manufacturer of the membrane roofing system.

F. Before beginning any installation of the membrane roofing system, the Contractor shall have the representative of the manufacturer of the roofing system examine the roof surfaces to ensure that the deck preparation is acceptable.

G. NOT USED.

H. "Adequate drainage" shall mean that the roof surfaces shall completely drain of standing water within twelve (12) hours after the cessation of precipitation.

3.03 APPLICATION

A. Application shall be in strict accordance with the approved manufacturer's printed specifications and details submitted in accordance with 1.07 herein.

B. Provide protection as required by the manufacturer for the membrane roofing system from damage due to the elements and due to contact with the underlying surface materials where such would have an adverse effect on the roofing system.

C. Roofing membranes shall not be stressed or stretched during application.

D. Flashing, edges, fascias, and other metal construction items and accessories shall be constructed in accordance with design details as shown on the Contract Drawings and in accordance with approved Shop Drawings.

E. Exercise care to prevent moisture from entering beneath any completed sections of roof. Temporarily seal and make watertight any loose edges of the membrane when the weather threatens and at the conclusion of each day's work.

F. Remove all roofing materials from surfaces other than those requiring such materials.

G. The roofing membrane system manufacturer's representative shall be present at the final inspection specified in 1.05D to certify that the roofing system has been installed properly.

3.04 INSTALLATION

A. Insulation

1. Insulation panels shall be installed with end joints offset. Edges of panels shall be in moderate contact, falling into place without force or deformation being required. Insulation shall be used only as a substrate; approved treated wood is the only acceptable cant strip material.
2. Install form (cover) board where required by the manufacturer or where shown on the Contract Drawings.
3. The primary layer of insulation shall be mechanically fastened using approved fasteners or unless otherwise shown on the Contract Drawings. Fastener pattern, frequency and installation shall be as required for compliance with the provisions and references of this Specification.
4. Additional layers of insulation, including tapered insulation, as shown on the Contract Drawings or as required to comply with thermal resistance ratings or for proper drainage, shall be set with manufacturer's approved insulation adhesive. Each panel shall be laid in accordance with the roofing manufacturer's installation instructions. Insulation panels installed shall meet the roofing manufacturer's maximum panel size for cold adhesive application.

B. Roof Membrane

1. Membrane Application

   a. Application of roofing shall be in accordance with roofing system manufacturer's instructions or the requirements herein, whichever is more stringent. Application of roofing shall immediately follow application of base sheet and/or insulation as a continuous operation.

2. Priming

   a. Prime metal flanges, concrete and masonry surfaces with a uniform coating of asphalt primer in compliance with ASTM D41.

3. Not Used
4. Not Used
5. Not Used
6. Bitumen Consistency

   a. Cutting or alteration of bitumen, primer and sealants shall not be permitted.

7. Not Used
8. Roofing application

   a. All layers of roofing membranes shall be laid in accordance with the roofing manufacturer's installation instructions. Sufficient pressure shall be exerted on the roll during application to ensure prevention of air pockets. The modified bitumen base ply shall be fully bonded to the prepared substrate and shall have a minimum of three (3) inch sides and end laps. Lap seams in the base ply layer shall not coincide with the lap seams of the cap sheet layer. The courses shall be staggered to ensure compliance.

9. Granule Embedment (for granular finish cap sheet)

   a. Mineral granules shall be broadcast over all bitumen overruns on the cap sheet surface to ensure a monolithic granular surface color.

10. Flashing application - Masonry

    a. Flashing shall be accomplished using the modified base ply membrane as the reinforcing sheet and the smooth or granular finished cap sheet as the modified bitumen flashing membrane. The cap sheet flashing shall be applied in three (3) foot lengths cut from the end of the roll. The reinforcing sheet shall be lapped a minimum of three (3) inches to itself and shall extend a minimum of six (6) inches onto the base surface and three (3) inches up the parapet wall above the cant. Lap seams in the reinforcing layer shall never coincide with the laps of the cap sheet flashing layer. The reinforcing sheet shall be cold adhered (both wall and sheet).

11. Water Cut-Off

a. At end of each day's work or when precipitation is imminent, a water cut-off shall be built at all open edges. Cut-offs may be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs shall be completely removed prior to the resumption of the roofing installation.

12. Preformed Metal Edges and Flashing

a. Metal edges shall be completely primed and allowed to dry prior to installation. After the base ply and top ply membrane has been applied, install galvanized cant dam. Fasten cant dam through the face and flange. Fasten per Factory Mutual requirements. The cant dam shall be stripped in using nine (9) inch wide strips of the cap sheet ply membrane. The aluminum fascia where noted in the Contract Drawings, including miters, spillouts and sumps shall then be installed per the manufacturer's specifications.

13. Horizontal pipes and conduits

Use the following method only where such elements are shown on the Contract Drawings, or where directed by the Engineer.

a. These shall be supported using treated wood blocking and the membrane manufacturer's walkway pad material. The blocking shall be four (4) inches by four (4) inches by twelve (12) inches long, positioned longitudinally with the pipe. Walkway pads shall be cut to overhang the base of the blocking by two (2) inches in all directions. The pipe shall be mechanically fastened to the center of each block. The blocks shall be spaced to prevents sagging or deformation of the pipe.

14. Pitch pockets

a. The metal penetrating item shall be completely cleaned of all roofing materials. The inside wall of the pitch pocket shall be cleaned of residual oil coating using Naptha solvent and etched using 5% solution of acetic acid. The flanges shall be primed and allowed to dry. After the base ply membrane has been applied, the flange shall be set in mastic and secured to the deck. Flanges shall be stripped in using nine (9) inch wide strips of base ply membrane. Pitch pockets shall be filled with non-shrink grout to a level two (2) inches below the top rim. Fill remainder of pitch pocket with urethane pitch pocket filler, sloped for quick drainage. The cap sheet membrane shall terminate at the flange-wall juncture. Install a watertight umbrella over the penetration item.

15. Walkway pads

a. Walkway pads where shown on the Contract Drawings shall be provided by the roofing membrane manufacturer. Walkway pads shall be cut into maximum panel lengths of five (5) feet, with a one (1) inch space for water drainage between each piece. Walkway pads shall be adhered to the cap sheet membrane. The color of the pads shall be contrasting to that of the cap sheet membrane, as approved by the Engineer. The material shall be installed with the manufacturer's label turned up to be visible.

16. Sealant

a. All cap sheet edges exposed at all penetrations, such as gravel stops, vent stacks, pitch pockets, and pipe penetrations, shall be caulked with a smooth continuous bead of approved sealant. All contact surfaces shall be free of grit, dirt, oil or any other contaminant that diminishes the quality of the installation.

17. Adhesive Coating Application

a. Apply coating at rate of two (2) gallons per one hundred (100) square feet. Apply coating in two separate applications allowing first coat to dry thoroughly before application of second coat. Coating may be applied by spraying or brushing.

3.05 PROTECTION

A. Provide special protection or avoid heavy traffic on the newly completed installation for a period of time as required by the manufacturer.

B. Restore to original condition or replace materials damaged during handling of roofing materials.

C. At all times during the Work, the Contractor must provide whatever measures are required to prevent water from penetrating through the roof surfaces. If a water condition develops, the Contractor must respond immediately on a 24 hour basis to take corrective action.

D. Maintenance Instructions

1. Prior to the issuance of the Certificate of Partial or Final Completion, the Contractor shall have the roofing manufacturer prepare and submit to the Engineer written instructions for recommended inspection and preventive maintenance which shall be carried out in order to keep the roofing system in a continuously weatherproofed condition.

E. All areas of and around the job site shall be cleaned of debris, roofing materials, equipment and all other roofing related items, after completion of the work.

F. Membrane Protection

1. Protection against staining and mechanical damages shall be provided for newly applied roofing and adjacent surfaces throughout the execution of the Work.

END OF SECTION

SECTION 07567

TWO PLY SEBS MODIFIED BITUMEN ROOFING SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Certificates

1. Submit written evidence of approval of the Contractor or other entity performing the Work by the membrane roofing system manufacturer.
2. The roofing system manufacturer shall have tested and certified by a recognized testing lab the following:
   a. SEBS cold adhesive meets or exceeds the provisions of EPA 600/R-93-116, ASTM D2196-86 (1991), ASTM D6511-00, and ASTM D93-97.
3. Submit evidence of Underwriters' Laboratories acceptance of the proposed roofing system (including cold adhesive) for a Class A or Class B rating as required by this Section.
4. Submit, prior to ordering material, certification from the roofing system manufacturer that:
   a. Materials, flashing, fasteners, insulation, separation sheet, walkway pads, sealants and all components furnished conform to the requirements of this Section.
   b. Materials furnished are compatible with the type of deck shown on the Contract Drawings, each one to the other and to adjacent related Work.
5. Submit, prior to the installation of the roofing system, certified test results including dates when tests were conducted, in the presence of the Engineer and a representative of the roofing system manufacturer, confirming that for every twenty thousand (20,000) square feet of roof area or part thereof, a minimum amount of twelve (12) random hydraulic pull-out tests of the fasteners obtained a minimum average pull-out load of three hundred fifty (350) pounds for gypsum or tectum decks and wood decks.
6. The Contractor shall submit the Manufacturer's stamped and signed approvals along with samples required by this Section.

B. Shop Drawings:

1. Prior to the installation of the roofing system, the Contractor shall prepare and submit to the Engineer for approval, detailed shop drawings including sketches or diagrams showing the insulation fastening patterns.
2. Shop drawings of the various sections or details encountered on the roof, shall be prepared and submitted for approval even though not shown on the Contract Drawings.
3. Each standard detail submitted shall be specifically labeled for this Contract and hand stamped approved by the manufacturer with current date and signature including the Contractor's name, project title, Contract Number and shall be indicated as a standard detail on the transmittal letter.
4. Shop drawings shall indicate all the proprietary names of the materials being used for this Contract.

C. Samples and Manufacturer's Literature

Submit prior to ordering materials: Samples of each element of the roofing system to be used including sheet membranes, insulation, fasteners, flashings and sealants in triplicate for approval by the Engineer. Sample sizes shall be as follows:

1. Twelve (12) inch square of base and primary membrane sheet.
2. Twelve (12) inch square of roof insulation system.
3. Twelve (12) inch long by six (6) inch girth of metal flashing material or metal covered composite material.
4. Twelve (12) inch length of metal fascia.
5. Twelve (12) inch square of vapor seal membrane sheet (if indicated on the Contract Drawings.)

D. Product Data

1. Latest edition of manufacturer's roofing and flashing product data sheets, including specifications and details along with printed instructions for applying materials and patching for making repairs.
2. Verification of material physical properties by an independent laboratory. Provide certification stamp and authorized signature for laboratory.

E. Design Calculations:

Submit wind uplift calculations signed and sealed by a Professional Engineer licensed in the state where the work is performed.

F. Sustainable Design Submittal Requirements

The contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      (1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).
      (2) The assembling location of the supplied product(s)
      (3) The location (source) of the raw materials used to manufacture the supplied product(s)
      (4) The VOC content of all adhesives, sealants, paints, and coatings applied on site as part of this work.
      (5) Supporting documentation and calculations indicating ENERGY STAR® compliance AND "high emissivity" (emissivity of at least .9 when tested in accordance with ASTM E408-71) roofing for a minimum of 75% of the roof surface;
2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.

3. Product cut sheets for materials that meet the SDMCF.

4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufacturer's literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).

5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

G. Submit to the Engineer one copy of USDOL Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during the Work.

H. Job Schedule

1. Prior to the Pre-Installation Meeting, submit proposed schedule for performing the Work.

END OF APPENDIX "A"

SECTION 07567

TWO PLY SEBS MODIFIED BITUMEN ROOFING SYSTEM

APPENDIX "B"

CONTRACTOR'S GUARANTEE

A. The Contractor hereby agrees to the following for the benefit of the Authority:

1. The Contractor assumes the obligation of making all repairs or replacements required to remedy any defects occurring in the roofing system furnished and installed under Contract #415-11-30, Bayonne Bridge: Replacement of Main Span Roadway and Approach Structure, hereinafter referred to as the "Contract" or "subject Contract", (including damage to the roofing system caused by the elements and damage due to ordinary wear and tear on the roofing system) occurring during the period either within five (5) years from the date of the issuance of a Certificate of Final Completion for the subject Contract, or until all repairs required pursuant to the inspection described in subparagraph A.2. below are completed, whichever date is later. As used herein "roofing system" shall include, but not be limited to, those items listed in this Section.

2. On a date agreeable to the Contractor and the Authority, between forty-five (45) and (30) days before the expiration of the period noted in subparagraph A.1. above, the Authority's Engineer and a qualified representative of the Contractor shall inspect the roofing system for defects, including, but not limited to:

   a. Actual leaks and damage to the roofing system,
   b. Separations or slippage of membrane or any signs of movement,
   c. Buckles, cracks, splits and open seams, or
   d. Any other defects which would lessen the service life of the roofing system.
   e. After such inspection the Contractor shall perform all repairs required, as determined by the Engineer.

3. All repairs required hereunder shall be made promptly, including those repairs requiring removal and replacement of defective portions of the roofing system, and all repairs shall be performed in full compliance with all the appropriate provisions of the Specifications for the subject Contract, and to the satisfaction of the Engineer.

4. For repairs or replacement of portions thereof required under this Guarantee which the Contractor demonstrates, to the full and complete satisfaction of the Engineer, are necessitated by damage which has resulted from structural failures, settling, shifting, and distortions, where the Contractor has not furnished and installed the underlying construction responsible for the roof defect, and erection or construction by others through the roofing membrane or flashing, the Contractor will be reimbursed by the Authority for repairs requested at a price to be agreed upon by the Engineer and Contractor (but in no event shall said price exceed the Contractor's price to other customers for equivalent repairs within a thirty (30) mile radius of New York City, NY). All other obligations of the Contractor under this guarantee shall be discharged without expense to the Authority.

5. In addition to the Guarantee by the Contractor described herein, and not in limitation thereof, the Contractor agrees, for the benefit of the Authority, to procure at his own expense from the manufacturer of the approved roofing system the Manufacturer's Guarantee set forth in Appendix "C". A copy of the Manufacturer's Guarantee shall be furnished to the Engineer before, and as a condition precedent to, the issuance of the Certificate of Final Completion.

B. This Contractor's Guarantee and the above-mentioned Manufacturer's Guarantee shall not be a limitation on any rights which the Authority would have, either expressed or implied either under the Contract, in equity, at law, or otherwise, such Guarantees being given only for the greater assurance of the Authority. The Authority shall have the option of requiring repairs and replacements to be performed either by the Contractor pursuant to the subject and this Contractor's Guarantee Contract or by the roofing system manufacturer pursuant to the Manufacturer's Guarantee, as the Engineer shall determine to be in the best interest of the Authority.

C. Exclusions:

1. Damage from tornadoes, hurricanes and similar cyclonic storms whose sustained winds exceed 74.5 miles per hour, designated as such by the nearest United States Weather Bureau station.
2. Not Used
3. Damage from direct lightning strikes.
4. Damage caused specifically by hail, as proven to the satisfaction of the Authority by the manufacturer.

_____
(Type or Print Name of Contractor)

By: _____
(Signature of Officer Authorized to Bind Contractor)

_____
(Type or Print Title of Officer Authorized to Bind Contractor)

_____ _____
(Contractor's Corporate Seal) (Type or Print Date)

END OF APPENDIX "B"

SECTION 07567

TWO PLY SEBS MODIFIED BITUMEN ROOFING SYSTEM

APPENDIX "C"

MANUFACTURER'S GUARANTEE

A. In order to induce the Port Authority of New York and New Jersey to approve the roofing system manufactured by the undersigned for installation under Port Authority Contract #415-11-30, Bayonne Bridge: Replacement of Main Span Roadway and Approach Structure, hereafter referred to as the "Contract or the subject Contract", the undersigned agrees to the following for the benefit of the Port Authority of New York and New Jersey.

1. The undersigned assumes the obligation of making all repairs or replacements required to remedy any defects occurring in the roofing system furnished and installed under the subject Contract (including damage to the roofing system caused by the elements and damage due to ordinary wear and tear on the roofing system) occurring during the period either within thirty (30) years from the date of the issuance of a Certificate of Final Completion for the subject Contract, or until all repairs required pursuant to the inspection described in subparagraph A.2. below are completed, whichever date is later. As used herein "roof system" shall include those items listed in this Section.

2. On a date agreeable to the manufacturer and the Authority, between forty-five (45) and thirty (30) days before the expiration of the period noted in subparagraph A.1. above, the Authority's Engineer and a qualified representative of the manufacturer shall meet to inspect the roofing system for defects, including, but not limited to:
   a. Actual leaks, damage to the roofing system,
   b. Separations or slippage of membrane or any signs of movement,
   c. Buckles, cracks, splits and open seams, or
   d. Any other defects that would lessen the service life of the roofing system.
   e. After such inspection the manufacturer shall perform all repairs required, as determined by the Engineer.

3. All repairs required hereunder shall be made promptly, including those repairs requiring removal and replacement of defective portions of the roofing system, and all repairs shall be performed in full compliance with all the provisions of the Specifications for the subject Contract, and to the satisfaction of the Engineer.

4. For repairs or portions thereof required under this Guarantee which the manufacturer demonstrates, to the full and complete satisfaction of the Engineer, as necessitated by damage which has resulted from structural failures, settling, shifting, distortions, splitting or cracking of substrate or separations between roof sections or between roof sections and parapets (except where expansion joints are provided), and where there has been erection or construction by others through the roofing membrane or flashing, the manufacturer will be reimbursed by the Authority for repairs requested, at a price to be agreed upon by the Engineer and the manufacturer (but in no event shall said price exceed the manufacturer's price to other customers for equivalent repairs within a thirty (30) mile radius of New York City, NY). All other obligations of the manufacturer under this Guarantee shall be discharged without expense to the Authority.

B. Exclusions:

1. Damage from tornadoes, hurricanes and similar cyclonic storms whose sustained winds exceed 74.5 miles per hour, designated as such by the nearest United States Weather Bureau station.
2. Not Used
3. Damage from direct lightning strikes.
4. Damage caused specifically by hail, as proven to the satisfaction of the Authority by the manufacturer.

_____
(Type or Print Name of Roofing System Manufacturer)

By: _____
(Signature of Officer Authorized to Bind Roofing System Manufacturer)

_____
(Type or Print Name of Officer Authorized to Bind Roofing System Manufacturer)

_____ _____
(Corporate Seal) (Type or Print Date of Signature)

END OF APPENDIX "C"

DIVISION 7

SECTION 07620

PREFABRICATED FORMED ALUMINUM FASCIA PANEL SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for prefabricated formed aluminum fascia panel systems.

B. Metal copings, if shown on Contact Drawings, are specified in Division 7 Section of these Specifications entitled "Metal Coping".

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American National Standards Institute (ANSI)

ANSI A 58.1 Minimum Design Loads for Buildings and Other Structures.

American Society for Testing and Materials (ASTM)

ASTMB209 Aluminum and Aluminum-Alloy, Sheet and Plate.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Where fascia panel support systems are shown on the Contract Drawings, furnish and install fabrications designed in accordance with 2.04 B.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of 2.02 and 2.03, furnish and install products of one of the following, or approved equal:

Englert, Inc.; Perth Amboy, NJ
Foremost Manufacturing Co.. Southfield, MI
Merchant and Evans Industries, Inc.; Burlington, NJ
MM Systems Corp.; Tucker, GA
Vistawall Architectural Products; Terrell, TX
W.P. Hickman Company; Asheville, NC

2.02 MATERIALS

A. Aluminum Sheet

Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish shown, but with not less than the strength and durability properties specified in ASTM B209 for 5005-H16.

B. Miscellaneous Materials

1. Exposed Fasteners

Stainless steel, non-magnetic, of type and size standard with manufacturer for product and application shown on the Contract Drawings. Match finish of exposed heads with material being fastened.

2. Concealed Fasteners

Same metal as item fastened or other non-corrosive metal as recommended by the manufacturer.

3. Mastic Sealant

Polyisobutylene; nonhardening, nonskinning, nondrying, and nonmigrating sealant.

4. Butyl Rubber Seal: Manufacturer's standard type.

2.03 CONSTRUCTION FEATURES

A. Provide formed aluminum fasciae designed and fabricated to fit applications shown on the Contract Drawings and to perform optimally with respect to weather resistance, water tightness, durability, strength and uniform appearance.

B. Expansion Provisions

Fabricate fasciae to allow controlled expansion in running lengths not only for movement of metal components in relationship to one another but also to adjoining dissimilar materials in a manner which is sufficient to prevent water leakage, deformation or damage.

2.04 FABRICATION

A. Formed Aluminum Panels

Manufacturer's standard modular panels formed from aluminum sheets not less than shapes and sizes shown on the Contract Drawings. Include trim, closure strips and other accessories shown on the Contract Drawings or required for proper installation. Provide aluminum sheet of 0.040-inch minimum thickness, unless otherwise shown on the Contract Drawings.

B. Fascia Panel Support System (if any)

Manufacturer's standard metal support system consisting of horizontal girts and vertical framing members including special connectors; of proper type for, and by manufacturer of, fascia panel system. Unless otherwise shown on the Contract Drawings, provide components and spacing designed to withstand 100 mph wind, per ANSI A 58.1, Exposure C.

C. Aluminum Finishes

1. General

Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendation, except as otherwise shown on the Contract Drawings. For components which are assembled or welded in factory, apply finish after fabrication is completed. Provide colors or color matches as shown on the Contract Drawings or, if not shown, as selected by the Engineer from the manufacturer's standard colors and samples submitted in accordance with Appendix "A".

2. Provide the following finish(es) where shown on the Contract Drawings:

a. Mill Finish

AA-M10 (Unspecified Mill Finish) standard mill finish provided by the manufacturer.

b. Class 1 Clear Anodized Finish

AA-M22C22A41 (Medium satin directional textured mechanical finish; chemical etch, medium matte; 0.7-mil thick anodic coating.) Apply protective coating of clear acrylic lacquer; comply with NAAMM recommendations.

c. Class I Color Anodized Finish

AA-C22A42 (Medium matte etched finish with 0.7-mil thick integrally colored anodic coating. Apply protective coating of clear acrylic lacquer; comply with NAAMM recommendations.

d. Baked Enamel Finish

AA-C12C42R1x (cleaned with inhibited chemicals, conversation coated with an acid-chromate-flouride-phosphate treatment, and painted with manufacturer's standard thermosetting acrylic enamel, 0.8 mil minimum dry film thickness.)

e. High Performance Coating

AA-C12C42R1x (cleaned with inhibited chemicals, conversion coated with an acid-chromate-fluoride-phosphate treatment and painted with fluorocarbon coating; inhibited thermo-cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.) Apply in strict compliance with coating manufacturer's instructions using an applicator approved by the coating manufacturer to apply its product.

(1). Comply with minimum requirements of AAMA 2605.

(2). Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of chalk ratings of 8 according to ASTM D4214; and without fading in excess of 5 Hunter units.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Comply with the manufacturer's written installation instructions and recommendations. Coordinate with installation of other substrates to receive Work of this Section as required to ensure that each element of the Work performs properly; and that combined elements are waterproof and weathertight. Anchor products included in this Section securely to structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation

Where metal surfaces of units are installed in contact with dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation as recommended by fascia panel manufacturer.

C. Clean exposed metal surfaces in accordance with the manufacturer's instructions. Touch-up damaged metal coatings.

3.02 PROTECTION

Provide protective measures as required to ensure that the Work of this Section will be without damage or deterioration at time of issuance of the Certificate of Final Completion.

END OF SECTION

SECTION 07620

PREFABRICATED FORMED ALUMINUM FASCIA PANEL SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's technical product data, installation instructions and general recommendations for each fascia product required. Include data substantiating that materials and performance comply with specified requirements.

B. Shop Drawings

Indicate layout, joining, profiles, accessories, anchorages, flashing connections and relationship to supporting structure and to adjoining roof and wall construction. Where fascia panel support system is installed under this Contract, indicate design wind velocity and conformance to 2.04 B.

C. Samples

Completely finished samples for each type of fascia and finish required. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations. Furnish 8-inch square samples.

END OF APPENDIX "A"

DIVISION 7

SECTION 07625

METAL COPING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for metal coping.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM B 209 Aluminum and Aluminum-Alloy, Sheet and Plate.

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

Architectural Sheet Metal Manual.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual.

1.03 QUALITY ASSURANCE

Provide products that comply with applicable requirements of SMACNA "Architectural Sheet Metal Manual," except as otherwise shown on the Contract Drawings.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements elsewhere herein, furnish and install products of one of the following, or approved equal:

C/S "Snap-Lock Coping" Construction Specialties, Inc.; Cranford, NJ
"Snap-Lok Coping" MM Systems Corp.; Tucker, GA
ME #104 "Neolock Coping" Merchant and Evans Industries, Inc.; Burlington, NJ
"Permasnap Coping" W.P. Hickman Co.; Asheville, NC

2.02 MATERIALS

A. Aluminum Sheet

Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish shown on the Contract Drawings but with not less than the strength and durability properties specified in ASTM B 209 for 5005-H134.

B. Miscellaneous Materials

1. Concealed Fasteners

Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.

2. Mastic Sealant

Polyisobutylene; non-hardening, nonskinning, nondrying, and nonmigrating sealant, if required.

3. Butyl Rubber Seal: Manufacturer's standard type.

2.03 CONSTRUCTION FEATURES

A. Provide coping(s) designed and fabricated to fit applications shown on the Contract Drawings and to perform optimally with respect to weather resistance, water tightness, durability, strength, and uniform appearance.

B. Expansion Provisions

Fabricate copings to allow controlled expansion in running lengths not only for movement of metal components in relationship to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner which is sufficient to prevent water leakage, deformation or damage.

2.04 FABRICATION

A. Interlocking Multi-Part Coping System

Provide manufacturer's standard system consisting of coping formed from aluminum sheet to profile and of thickness specified in this Section, zinc-coated steel or aluminum anchor plate or cleat located at coping joint, and formed aluminum gutter chair or gutter/splice plate or compression pad/gutter; with prefabricated inside and outside corners, miters welded before finishing; without exposed fasteners.

B. Thickness of coping shall be 0.050 minimum, unless shown otherwise on the Contract Drawings.

C. Aluminum Finishes

1. General

a. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise specified in this Section or shown on the Contract Drawings. For components that are assembled or welded in factory, apply finish after fabrication is completed.

b. Provide colors or color matches as shown on the Contract Drawings, if not shown, as selected by Engineer from manufacturer's standard colors and samples submitted in accordance with Appendix "A".

2. Provide the following finish(es) where shown on the Contract Drawings:

a. Mill Finish

AA-M10 (Unspecified Mill Finish) standard mill finish provided by manufacturer.

b. Class II Clear Anodized Finish

AA-M22C22A31 (Medium satin directional textured mechnanical finish; chemical etch, medium matte; 0.4-mil thick anodic coating.)

c. Class I Color Anodized Finish

AA-C22A42 (Medium matte etched finish with 0.7 mil thick integrally colored anodic coating.)

d. Baked Enamel Finish

AA-C12C42R1x (Cleaned with inhibited chemicals, conversion coated with an acid-chromate-flouride-phosphate treatment, and painted with manufacturer's standard thermosetting acrylic enamel, 0.8 mil dry film thickness.)

e. High Performance Coating

AA-C12C42R1x (Cleaned with inhibited chemicals, conversion coated with an acid-chromate-fluoride-phosphate treatment and painted with fluorocarbon coating; inhibited thermo-cured primer, 0.2 minimum mil dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.)

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Comply with manufacturer's written installation instructions and recommendations. Coordinate with installation of roofing membrane, flashing and wall construction as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor products included in this Section securely to structural substrates and adequately to withstand lateral and thermal stresses.

B. Isolation

Where metal surfaces of units are installed in contact with dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation as recommended by coping manufacturer.

3.02 PROTECTION

A. Clean exposed metal surfaces in accordance with the manufacturer's instructions. Touch-up damaged metal coatings.

B. Provide protective measures as required to ensure that Work of this Section will be without damage or deterioration at time of issuance of the Certificate of Final Completion.

END OF SECTION

SECTION 07625

METAL COPING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

07625A01 Indicate layout, joining, profiles, accessories, anchorages, flashing connections and relationship to adjoining roof and wall construction.

Samples

07625C01 Completely finished samples for each type of coping and finish required. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations. Provide 12-inch long samples of each type of coping finish.

Product Data

07625D01 Manufacturer's technical product data, installation instructions and general recommendations for each coping product required. Include data substantiating that materials and performance comply with manufacturers requirements and requirements of this Section.

END OF APPENDIX "A"

DIVISION 7

SECTION 07627

METAL CAP FLASHING AND GRAVEL STOPS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the furnishing and installation of metal cap flashing and gravel stops.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society of Testing and Materials (ASTM)

ASTM B209 Aluminum and Minimum Alloy Sheet and Plate.

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

Architectural Sheet Metal Manual.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance and durability of Work and protection of materials and finishes.

1. Coordinate with concrete and masonry entities to ensure that all reglets to be incorporated into concrete and masonry, where shown on the Contract Drawings, are properly formed to shapes and lengths required for easy installation.

B. Materials and installation(s) of Work of this Section shall be compatible with and shall be performed in accordance with the requirements of Work of the roofing system specified in other Sections of the specifications. Work of this Section shall become a part of the Roofing System Warranty, if any, as specified in such other Sections of these specifications.

1.04 QUALITY ASSURANCE

A. Industry Standards

Provide products which comply with applicable requirements of SMACNA "Architectural Sheet Metal Manual," except as otherwise shown on the Contract Drawings.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide products of one of the following, or approved equal:

Construction Specialties, Inc., Muncy, PA
Foremost Manufacturing Co., Southfield, MI
V.P. Hickman Co., Asheville, NC
MM Systems Corp., Tucker, GE
Peterson Aluminum Corp., Elk Grove Village, IL

2.02 MATERIALS

A. Aluminum (Cap Flashing)

ASTM B209, alloy 3003, temper H14, 0.032-inch thick (20 gage), except as otherwise shown on the Contract Drawings.

B. Stainless Steel (Cap Flashing)

ASTM A167, Type 316L, dead soft temper. 0.0179-inch thick (26 gage)

C. Extruded Aluminum (Gravel Stop)

Manufacturer's standard extrusions of sizes and profiles indicated; 6063-T52; 0.060-inch minimum thickness for primary legs of extrusions, except as otherwise shown on the Contract Drawings.

D. Galvanized Steel Cant Dam

Commercial grade galvanized steel, manufacturer's standard gage for size gravel stop as shown on the Contract Drawings.

E. Fasteners

Same metal as cap flashing or gravel stop, or other noncorrosive metal as recommended by the manufacturer. Match finish of exposed heads with material being fastened.

F. Mastic Sealant

Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

G. Epoxy Seam Sealer

Two-part noncorrosive metal seam cementing compound, recommended by the metal manufacturer for exterior/interior non-moving joints including riveted joints.

H. Reglets

Metal units 0.040-inch thick, unless otherwise shown on the Contract Drawings; of type and profile as shown on the Contract Drawings compatible with flashing indicated, noncorrosive.

I. Metal Accessories

Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of Work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

J. Finishes (at all exposed surfaces)

Provide the following finish, unless otherwise shown on the Contract Drawings:

High Performance Coating AA-C23C42Rlx (cleaned with inhibited chemicals, conversion coated with an acid-chromate-fluoride-phosphate treatment and painted with organic coating specified below). Apply in strict compliance with coating and resin manufacturer's instructions using a licensed applicator.

1. Fluorocarbon Coating

Inhibited thermo-cured primer, 0.2 min. mil dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil min. dry film thickness.

a. Comply with minimum requirements of AAMA 2605.

b. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of chalk rating of 8 according to ASTM D4214; and without fading in excess of 5 Hunter units.

2.03 FABRICATION

A. General Metal Fabrication

Shop-fabricate Work to the greatest extent possible. Comply with details and sizes as shown on the Contract Drawings and specified in this Section and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for and running work, sufficient to permanently prevent leakage, damage or deterioration of the Work. Form Work to fit substrates. Comply with material manufacturer's printed instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

B. Seams

Form seams with epoxy seam sealer; rivet joints for additional strength where required.

C. Expansion Provisions

Where lapped or bayonet-type expansion provisions in the Work cannot be used or would not be sufficiently water/weather-proof or where shown on Contract Drawings, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints

Where movable, non-expansion type joints are shown on Contract Drawings or required for proper performance of the Work, form metal to provide for proper installation of elastomeric sealant specified in other sections of these specifications and in compliance with SMACNA standards.

E. Separations

Provide for separation of metal from incompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by the manufacturer/fabricator.

F. Gravel Stops

Fabricate gravel stops running units with formed or joint covers.

G. All corners shall be shop-formed and shop-welded.

PART 3. EXECUTION

3.01 EXAMINATION

Ensure that curbs, cants, base flashing and other associated roof accessories and interfacing Work have been prepared to receive Work of this Section in accordance with recommendations of the roof system manufacturer.

3.02 INSTALLATION

A. General

Except as otherwise shown on the Contract Drawings, comply with the manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual". Anchor units of Work securely in place by methods indicated herein or as shown on the Contract Drawings, providing for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as shown on the Contract Drawings. Install Work with laps, joints and seams which will be permanently watertight and weatherproof.

B. Bed flanges of Work in a thick coat of roofing cement of a type acceptable to the roofing system manufacturer where required for waterproof performance.

C. Install reglets to receive cap flashing in the manner and by methods shown on the Contract Drawings, where shown in concrete, furnish reglets to trades of concrete Work for installation as Work of other Sections of these specifications. Where shown in masonry, furnish reglets for installation as Work of other Sections.

1. Install cap flashing in reglets either by snap-in seal arrangement, or by welding in place for anchorage and filling reglet with sealant, as specified in another Section of these specifications on sealants, and where shown on the Contract Drawings.

3.03 PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Protection

Protect flashings and sheet metal work during construction to ensure that Work will be without damage or deterioration, other than natural weathering, at the time of issuance of the Certificate of Final Completion.

END OF SECTION

SECTION 07627

METAL CAP FLASHING AND GRAVEL STOPS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product data, installation instructions and general recommendations for each specified product.

B. Shop Drawings

Shop drawings showing layout, joining, profiles and anchorages of cap flashing, gravel stops and accessories; layouts at 1/4 inch scale, details at 3 inches scale.

C. Samples

12-inch long samples of specified factory-fabricated products exposed as finished Work, in finish and color(s) shown on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 7

SECTION 07650

FLEXIBLE FLASHING - LAMINATED SHEET

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for flexible flashing - laminated sheet for wall and roof waterproofing.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

Sheet Metal and Air Conditioning National Assoc. (SMACNA)

Architectural Sheet Metal Manual

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements specified in this Section, provide products of one of the following:

A. "Cop-A-Bond Duplex", Afco Products, Inc., Somerville, MA

B. "Standard Cop-R Flash", Phoenix Building Products, Horsham, PA

C. "Cop-R-Tex Duplex", York Mfg., Inc., Sanford, MA

2.02 MATERIALS

A. Laminated-Sheet Composition Flashing

Copper/paper flashing of 5 oz. copper sheet laminated between 2 sheets of bituminous impregnated creped Kraft paper or saturated fabric.

B. Mastic Sealant

Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

PART 3. ECUTION

3.01 INSTALLATION

A. General

Except as otherwise shown on the Contract Drawings, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual". Anchor Work in place with adhesives, setting compounds or other devices as recommended by the manufacturer. Install Work with laps, and joints filled with polyisobutylene mastic which will be permanently watertight and weatherproof.

3.02 PROTECTION

Perform required procedures for surveillance and protection of flashings during construction to ensure that Work shall be without damage or deterioration, other than natural weathering at time of issuance of the Certificate of Final Completion.

END OF SECTION

SECTION 07650

FLEXIBLE FLASHING - LAMINATED SHEET

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

07650D01 Submit the manufacturer's products data, installation instructions and general recommendations for each specified sheet material and fabricated product, in accordance with the requirements of "Shop Drawings Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 7

SECTION 07720

PREFABRICATED CURB AND EQUIPMENT SUPPORT UNITS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for prefabricated curb and equipment support units.

1.02 REFERENCES

Not Used.

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements specified in this Section, furnish and install prefabricated curbs/equipment supports by one of the following, or approved equal:

Custom Curb, Inc.; Chattanooga, TN
The Pate Company; Broadview, IL
S & L Manufacturing Company; Newark, NJ
ThyCurb Div./ThyBar Corp.; Addision, IL

2.02 MATERIALS

A. Zinc-Coated Steel

Commercial quality with 0.20 percent copper, hot-dip galvanized, mill phosphatized.

B. Insulation

Manufacturer's standard rigid or semi-rigid board of glass fiber.

C. Wood Nailer

Softwood lumber, pressure treated with water-borne preservatives for aboveground use.

D. Fasteners

Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by the manufacturer.

2.03 CONSTRUCTION FEATURES

A. General

Comply with loading and strength requirements as shown on the Contract Drawings where units support other Work. Coordinate dimensions with approved rough-in sheets of shop drawings of equipment to be supported. Fabricate with welded or sealed mechanical corner joints, and with cant strips and base profile coordinated with roof insulation thickness. Provide wood nailers at tops of curbs, coordinate with thickness of insulation and roof flashings as shown on the Contract Drawings, and tapered where necessary to compensate for roof deck slopes of 1/4 inch per ft. and more to provide horizontal top. Except as otherwise required for strength, fabricate units of minimum 14-gage (0.0747 inch) metal, and to minimum height of 12 inches unless otherwise shown on Contract Drawings.

B. Provide manufacturer's standard units. Shop-fabricate each unit.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Comply with the manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, vapor barriers, roof insulation, and roofing and flashing, as required to ensure that each element of the Work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrate, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation

Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. Cap Flashing

Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing as counterflashing. Seal with thick bead of mastic sealant.

END OF SECTION

SECTION 07720

PREFABRICATED CURB AND EQUIPMENT SUPPORT UNITS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

07720D01 Submit the manufacturer's technical product data, and dimensioned drawings indicating fastening method and installation instructions all in accordance with the requirements of Shop Drawings, Catalog Cuts, and Samples of Division 1 - GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 7

SECTION 07721

ROOF HATCHES AND HEAT/SMOKE VENTS

PART 1. GENERAL SUMMARY

1.01 SUMMARY

This Section specifies requirements for roof hatches and heat/ smoke vents.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

	American Society for Testing and Materials (ASTM)
ASTM A653	Steel Sheet, Zinc-Coated (Galvanized) (OR Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
	Federal Specifications (FS)
FS-TT-P-664D-	Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
29 CFR 1910.23	Fall Protection in General Industry Occupational Safety & Health Administration (OSHA), 200 Constitution Avenue NW, Washington, DC 20210
	National Fire Protection Association (NFPA)
NFPA 204M	Smoke and Heat Venting
	Steel Structures Painting Council (SSPC)
Paint 12	Cold Applied Asphalt Mastic (Extra Thick Film)
PA-1	Shop, Field and Maintenance Painting
	Underwriters Laboratories Inc. (UL)
	"Building Materials Directory"

1.03 QUALITY ASSURANCE

A. Heat/Smoke Vent Compliance Labels

Provide units which have been tested, listed and labeled in the UL Building Materials Index, as follows:

1. Construction/Operation: UL labeled

2. Fire Resistance of Lids: UL Class "A"

1.04 SUBMITTALS

For submittal requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide prefabricated roof hatch units and heat/ smoke vents by one of the following, or approved equal:

Babcock-Davis Hatchways, Inc., Arlington, MA
Bilco Co., New Haven, CT
Milcor, Inc., Lima, OH

2.02 MATERIALS

A. Zinc-Coated Steel

Structural-Quality Galvanized Steel Sheet: ASTM A653 with G90 coating, both sides.

B. Curb Insulation

Rigid or semi-rigid board of glass fiber, minimum 1-inch thickness.

C. Cover Insulation

Rigid or semi-rigid board of glass fiber, laminated honeycomb or rigid foam-type.

D. Wood nailers, and softwood lumber shall be of the same thickness as curb insulation, and pressure treated with water-borne preservatives for aboveground use.

E. Fasteners

Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by the manufacturer.

F. Gaskets

Tubular or fingered design of neoprene or polyvinyl chloride, or block design of sponge neoprene.

G. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

I. Shop Primer

Fast-curing, lead and chromate free, universal modified alkyd primer complying with performance requirements of FS TT-P-664, selected for resistance to normal atmospheric corrosion, compatible with substrates and finish paint systems shown on the Contract drawings, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.03 CONSTRUCTION FEATURES

A. Roof Hatches

1. General: Fabricate units to withstand loadings specified in applicable code, but not less than 40-lbf per sq. ft. external loading and 20-lbf per sq. ft. internal loading pressure. Frame with 9-inch-high, integral-curb, double-wall construction with 1-1/2 inch insulation, cant strips and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1-inch insulation core. Provide gasketing and equip corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

2. Type: Single-leaf personnel access, unless otherwise shown on the Contract Drawings.

3. Material: Zinc-coated steel sheets.

B. Hatch Rail System

1. Furnish and install where indicated on plans hatch rail system. The hatch rail system shall be field assembled and installed per the manufacturer's instructions.

2. Performance Characteristics:

a. High visibility safety yellow color shall be molded in.

b. Hatch rail system shall attach to the capflashing of the roof hatch and shall not penetrate any roofing material.

c. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.23 and shall meet OSHA strength requirements with a factor of safety of two.

d. UV and corrosion resistant construction with a twenty-five year warranty.

e. Self-closing gate shall be provided with hatch rail system.

3. Posts and Rails: Shall be round pultruded reinforced fire retardant yellow fiberglass treated with a UV inhibitor.

4. Hardware: Mounting brackets shall be ¼" thick hot dip galvanized steel. Hinges and post guides shall be 6063T5 aluminum. Fasteners shall be Type 316 stainless steel.

C. Heat/ Smoke Vents

1. General: Construct units to comply with NFPA 204M. Custom-fabricate units only to extent necessary to comply with dimensions shown on the Contract Drawings and other special requirements. Fabricate to withstand loadings specified in applicable code, but not less than a minimum 40-lbf per sq. ft. external live load and 20-lbf per sq. ft. uplift.

2. Material: Zinc-coated steel sheets.

3. Curbs: Same as specified above for roof hatches.

D. Fabricate Units of size(s) shown on the Contract Drawings with welded construction.

E. Sloping Roofs: Relationship of tops of units to roof deck construction (parallel to deck, tapered so as to remain level on a sloped deck construction, etc.) shall be as shown on the Contract Drawings.

F. Unit configuration, including flashing and counterflashing and special conditions, shall be as shown on the Contract Drawings.

2.04 SHOP PAINTING

A. Where painting is shown on the Contract Drawings, apply shop primer to all exposed surfaces, in compliance with requirements of SSPC-PA1 for shop painting.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Comply with the manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and vapor barriers, roof insulation, roofing and flashing; as required to ensure that each element of the Work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrate, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation

Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. Flange Seals: Unless otherwise shown on the Contract Drawings, set flanges of accessory units in a thick bed of roofing cement to form a seal.

D. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counterflashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

E. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

F. Heat-and-Smoke Vents: Locate, install, and test according to NFPA 204M.

G. The manufacturer shall furnish fasteners necessary for installing hatch rail system on hatch.

3.02 ADJUSTMENTS

A. Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

B. Touch up damaged metal coatings with primer to match and be compatible with original factory applied primer.

3.03 INSPECTIONS

A. Verify that hatch rail system installation will not disrupt other trades. Report and correct defects prior to any installation.

END OF SECTION

SECTION 07721

ROOF HATCHES AND HEAT/ SMOKE VENTS

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product data, installation instructions and general recommendations for each specified product.

B. Shop Drawings

Shop drawings showing layout, dimensions, joining profiles and anchoring of products to adjoining construction; layouts at ¼" inch scale, details at 3 inches scale.

C. Certifications

Manufacturer's certifications indicating compliance with specified UL and OSHA requirements.

END OF APPENDIX A

DIVISION 7

SECTION 07812

INTUMESCENT MASTIC FIREPROOFING

PART 1. GENERAL

1.01 SCOPE

This Section covers labor, materials, and equipment necessary for, and incidental to, the complete and proper application of intumescent mastic fireproofing to steel members on bridge structures in accordance with all applicable requirements of contract documents, whether or not the material or apparatus is specifically identified in this Section.

This Section covers only intumescent fireproofing for bridge steel structures. Intumescent paint for use in buildings or other non-bridge structures shall be as indicated on the plans.

In addition to the requirement of this specification, all work under this section shall comply with all applicable provisions in SECTION 09910 - PAINTING. In the event of conflicts, the more stringent requirements or provisions shall govern.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

Underwriters Laboratories (UL)

ANSI/UL 1709 Rapid Rise Fire Tests of Protection Materials for Structural Steel

The Society for Protective Coatings (SSPC)

SSPC-SP 10 Near-White Blast-Cleaning

1.03 SYSTEM DESCRIPTION

The intumescent mastic fireproofing material shall be applied in accordance with manufacturers' instructions and ANSI/UL 1709 listing requirements to achieve the fire resistance requirements described in Part 2 of this Section.

1.04 QUALITY CONTROL

A. Manufacturer Qualifications

1. Company specializing in manufacturing product in this Section with a minimum of 10 years documented experience.

2. Company's quality management system shall have been assessed and registered by an independent registrar as conforming to the requirements of ISO 9001.

B. Applicator Qualifications

In addition to the qualifications required in Section 09910, the company specializing in applying the work of this Section must have a minimum of 3 years documented experience in applying intumescent mastic coatings on similar structures and be certified by the manufacturer for application of their products.

C. Product

Manufactured under the UL Follow-up Service with each container bearing the certified UL label (mark).

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery

Materials shall be delivered in sealed containers properly marked and labeled to show manufacturer's name, brand and certification of compliance with requirements for the fire hazard and fire resistance classifications. Damaged containers found unsuitable for use in the work will be rejected and shall be removed from the site.

B. Storage

Materials shall be stored in strict accordance with Section 09910 and the manufacturer's documented instructions.

C. Documentation

Manufacturer Technical Data shall be submitted for review. In addition, all batch number, product identification and quantities shall be recorded on appropriate construction quality control (CQC) documents. A copy of the transport document and manufacturer's conformance certificate shall be attached to the material delivery CQC form.

1.06 PROJECT/SITE CONDITIONS

A. Project/Site Environmental Requirements

1. Protect work area from wind-blown dust and rain. Protect adjacent areas from over spray of fireproofing material.
2. Provide ventilation in areas to receive the work of this section per manufacturer's recommendation during application and a minimum of 24 hours after application.

B. Temperature and Humidity Requirements

Ensure that air and steel substrate temperatures as well as relative humidity in the areas where products are to be applied are within the ranges specified by the product manufacturer for a period of time spanning 24 hours prior to application to 24 hours after product application.

If necessary for maintaining the construction schedule, the Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

1.07 SEQUENCING AND SCHEDULING

Sequence and coordinate application of intumescent mastic fireproofing with work in other sections that would interfere with fireproofing application.

1.08 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

Intumescent Mastic Fireproofing system generally consists of three coating layers: Primer, Intumescent Mastic Coating, and Finish Coat. However, additional coating layers may be recommended by the manufacturer to enhance performance and durability of the fireproofing system.

A. Primer coating shall be compatible with the selected intumescent mastic coating as approved by the manufacturer and applied in accordance with the manufacturer's documented instructions.

B. Intumescent mastic coating shall be selected from one of the following products:

1. Chartek 1709 (manufactured by International Paint) – ANSI/UL 1709 Test Design No. XR625.
2. Thermo-Lag 3000 series (manufactured by Carboline) – ANSI/UL 1709 Test Design No. XR620.
3. Pitt-Char XP (manufactured by PPG Industries) – ANSI/UL 1709 Test Design No. XR612.

The thickness of intumescent mastic fireproofing shall be determined to provide a 2-hour fire resistance rating when tested in accordance with ANSI/UL 1709. Test data and calculations used to support the final mastic application thickness, and any required mesh reinforcement, shall be submitted to the Engineer for approval.

If used, mesh reinforcement material shall be selected in conformance with the corresponding ANSI/UL 1709 certification.

C. Finish topcoat shall be compatible with the selected intumescent mastic coating as approved by the manufacturer and shall be applied in accordance with manufacturer's documented instructions. Finish color shall match the color specified for bridge steel members.

PART 3. EXECUTION

3.01 PREPARATION

A. All surfaces to receive intumescent mastic fireproofing material shall be prepared in accordance with SSPC-SP 10, Near-White Blast-Cleaning. Surfaces shall be clean, dry and free of oil, grease, loose mill scale, dirt, dust or other foreign substances which would impair bond of the fireproofing material to the substrate.

B. Application of the intumescent mastic fireproofing shall not commence until the contractor, applicator and inspector have examined the surfaces to receive the fireproofing material and determined the surfaces are acceptable to receive the fireproofing material.

C. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturer's recommendations.

D. Verify that all clip hangers, piping, ducts, equipment or other items which would interfere with the application of intumescent mastic fireproofing material are not positioned or installed until fireproofing application is complete.

E. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated with intumescent mastic fireproofing material.

F. Weld spatter and defects shall be ground smooth prior to commencement of fireproofing application.

3.02 APPLICATION

A. Application Locations

The intumescent mastic fireproofing shall be applied at the selected dry film thickness as described in Part 2 at the locations identified in the Contract Drawings. All exposed surfaces within the limit of the fire protection shall receive intumescent mastic fireproofing materials.

B. Equipment and Application Procedures

Equipment and application procedures of intumescent mastic fireproofing system shall conform to manufacturer's recommended application instructions. In addition, the Contractor shall follow the general procedures as described below:

1. Apply primer to properly cleaned substrate in accordance with the manufacturer's application instructions.
2. Spray-apply intumescent mastic coating in one or more coats to the selected thickness as described in Part 2 in accordance with manufacturer's application instructions. The final coat of intumescent coating shall be lightly rolled with a paint roller.
3. If a reinforcing mesh is used, the mesh with the least weight shall be selected from the list of the material previously certified by ANSI/UL 1709 tests. The location and the depth of the mesh shall be in accordance with manufacturer's recommendations.

C. Finish Standard

The finish of the intumescent mastic coating shall be Normal Decorative Finish with reasonably uniform texture such as orange peel. The minimum dry film thickness applied shall be adjusted with a good general standard of cosmetic finish when viewed from a distance of 16.4 feet or more.

3.03 SAMPLES

Before proceeding with the work, the applicator shall apply the primer, intumescent mastic coating and finish top coat to a representative substrate section.

Materials shall be applied in accordance with manufacturer's recommended application instructions and the project requirements for fire rating thickness, finish texture and color.

The application shall be witnessed by the Engineer and shall be subject to their approval and shall be used as a guide for the finished work.

3.04 FIELD QUALITY CONTROL

The Contractor shall retain an independent testing laboratory, approved by the Engineer, to inspect and verify the application of intumescent mastic coating layer.

The intumescent mastic coating inspection shall be performed prior to the application of the finish (top) coat.

The results of the above tests shall be signed and sealed by a Fire Protection Engineer licensed in the state where the intumescent mastic coating is applied and shall be made available to the Engineer at the completion of each pre-designated area. The test results shall be approved by the Engineer prior to the application of finish (top) coat.

In-place intumescent mastic coating not in compliance with the requirements described in this Section shall be corrected prior to the application of the finish (top) coat.

3.05 CLEAN UP AND REPAIR

Upon completion of installation, all excess material, overspray and debris shall be cleared and removed from the job site.

Remove intumescent mastic fireproofing materials from surfaces not required to be fireproofed.

Should any intumescent mastic fireproofing material become damaged by the Contractor's activities after the installation, The Contractor shall repair the damage area at his cost. Repairs shall be performed by applicators certified by the intumescent mastic fireproofing manufacturer and shall be applied in accordance with the manufacturer's application instructions.

END OF SECTION

SECTION 07812

INTUMESCENT MASTIC FIREPROOFING

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples of Division 1 – GENERAL PROVISIONS:

A. Product Data

1. Submit product technical data describing product performance characteristics and limitations.
2. Submit data, including ANSI/UL 1709 test data and certifications, to support final application thickness and any required reinforcing mesh.

B. Samples

Submit samples of intumescent mastic fireproofing system for all thicknesses that will be applied to critical bridge components, as specified by the Contract Documents.

C. Intumescent Mastic Coating Field Inspection Reports

Submit intumescent mastic coating field inspection reports to the Engineer at the completion of each pre-designated area prior to the application of the finish (top) coat.

D. Qualifications

1. Applicator Qualifications: Submit applicator's qualifications and current certification as a manufacturer trained and approved applicator.

2. Manufacturer Qualifications: Submit manufacturer documentation certify that the manufacturer's fireproofing products comply with the requirements described in the Contract Documents.

E. Manufacturer's Application Instructions

Submit manufacturer's recommended application instructions.

END OF APPENDIX "A"

DIVISION 7

SECTION 07920

SEALANTS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies interior and exterior cold liquid-applied sealants, as shown on the Contract Drawings with the following designations:

1. ES-1: One-part non-acid curing silicone.
2. ES-2: One-part acid curing, mildew-resistant silicone.
3. ES-3: One-part or two-part non-sag polyurethane.
4. ES-4: One-part or two-part pourable polyurethane.
5. ES-5: Latex sealant for interior locations.
6. ES-6: One-part non-sag silyl-terminated polyether.

B. Horizontal joint sealants in concrete and asphalt roads and sidewalks (hot and cold liquid-applied) are specified in Division 2 Section on pavement joint sealing.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Architectural Manufacturers Association (AAMA)
AAMA CW-13	Structural Sealant Glazing Systems.
	American Society for Testing and Materials (ASTM)
ASTM C 834	Specification for Latex Sealants.
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM C 1021	Practice for Laboratories Engaged in Testing of Building Sealants.
ASTM C 1193	Guide for Use of Joint Sealants.
ASTM C 1330	Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
ASTM D 1056	Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Elastomeric joint sealants designated as ES-1 through ES-4, and E-6 shall establish and maintain watertight and airtight continuous seals without staining or deteriorating joint substrates when installed.

B. Nonelastomeric joint sealants designated as ES-5 shall establish and maintain airtight continuous seals that are water-resistant without staining or deteriorating joint substrates when installed.

C. Adhesion Test

When directed by the Engineer, perform preconstruction field adhesion test of each sealant per AAMA CW-13. Perform such tests in the presence of the Engineer and a qualified technical representative of the sealant manufacturer.

1. Notify Engineer and sealant manufacturer 7 days in advance of the dates and times when field adhesion tests are to occur.

2. Produce written report on test results.

3. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with the above requirements, will be considered satisfactory. Sealants that fail to adhere to joint substrates during testing shall not be used in the Work.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not proceed with the Work of this Section under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by sealant manufacturer.

2. When joint substrates are wet due to rain, frost, condensation or other causes.

3. Where joint widths are less than or greater than widths allowed by sealant manufacturer for applications shown on the Contract Drawings.

4. When contaminants capable of interfering with sealant adhesion are present on joint substrates.

1.05 QUALITY ASSURANCE

A. Installer Qualifications

Verify that the entity performing sealant installation has successfully completed within the last 3 years at least 3 joint sealant installations involving quantities and complexities at least equal to those required for Work of this Section.

B. Testing Laboratory Qualifications

Use an independent testing laboratory that demonstrates to Engineer's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM C 1021, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying progress of the Work.

C. Single Source Responsibility

Obtain sealant and primer materials from a single manufacturer for each different required product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to construction site in original unopened containers or bundles with labels clearly identifying the manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials.

B. Store and handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products of the following manufacturers, or approved equal:

A. ES-1 (One-part non-acid curing silicone)

Dow Corning 795; Dow Corning Corp., Midland, MI
SilPruf NB SCS9000; GE Sealants & Adhesives, Waterford, NY
Bondaflex 295; May National Associates, Inc., Clifton, NJ
Spectrem 2; Tremco Inc., Beechwood, OH

B. ES-2 (One-part acid curing, mildew-resistant silicone)

Dow Corning 786; Dow Corning Corp., Midland, MI
Sanitary SCS1700; GE Sealants & Adhesives, Waterford, NY
Bondaflex Sil 100 WF; May National Associates, Inc., Clifton, NJ
Proglaze; Tremco Inc., Beechwood, OH

C. ES-3 (One-part or two-part non-sag polyurethane)

Dynatrol I-XL or II; Pecora Corp., Harleysville, PA
Sikaflex 15LM or Sikaflex 2c NS; Sika Corp., Lyndhurst, NJ
Vulkem 921 or Dymeric 240; Tremco Inc., Beechwood, OH

D. ES-4 (One-part or two-part pourable polyurethane)

Sonolastic SL 1 or SL 2; Degussa Building Systems, Shakopee, MN
Urexpan NR-201 or NR-200; Pecora Corp., Harleysville, PA
Vulkem 45 or 245; Tremco Inc., Beechwood, OH

E. ES-5 (Latex sealant for interior locations)

AC-20 FTR; Pecora Corp., Harleysville, PA
Tremflex 834; Tremco Inc., Beachwood, OH
SHEETROCK Acoustical Sealant; United States Gypsum Co., Chicago, IL

F. ES-6 (One-part non-sag silyl-terminated polyether)

Sonolastic 150; Degussa Building Systems, Shakopee, MN
Bondaflex STP 25; May National Associates, Inc., Clifton, NJ
Pro-Sil[sct] 1; Pecora Corp., Harleysville, PA
Sikaflex-721 UV; Sika Corp., Lyndhurst, NJ

2.02 MATERIALS

A. Sealants (except designation ES-5)

1. Cold-applied elastomeric joint sealants shall conform to the following requirements of ASTM C 920:

   a. Type: S, except Type S or M for sealant designations ES-3 and ES-4.

   b. Grade: NS, except Grade P for sealant designation ES-4.

   c. Movement Class: 25 for sealant designations ES-2 and ES-4; 50 for sealant designations ES-1 and ES-3. Not applicable for sealant designation ES-5.

   d. Use: T, NT, M, G, A or O as applicable to joint substrate type shown on the Contract Drawings.

2. Sealant designation ES-5: Cold-applied nonelastomeric joint sealant; ASTM C 834.

3. Color

   a. At stone or masonry joints: Sealant color shall match adjacent mortar color, unless otherwise shown on the Contract Drawings, subject to Engineer's approval.

   b. At other locations: As shown on the Contract Drawings, or if not shown, as selected by the Engineer from manufacturer's standard colors.

B. Sealant Backing..

Furnish sealant backings of material and type which are nonstaining and are compatible with joint substrates, sealants, primers and other joint filler materials. Sealant backing shall be as approved by sealant manufacturer, based on field experience and laboratory testing, for applications shown on the Contract Drawings and shall be one of the following types:

1. Cylindrical Foam Sealant Backing (backer rod): ASTM C 1330; preformed, compressible, resilient, non-exuding lengths of polyethylene or polyolefin foam of size and density required to control sealant depth and contribute to producing optimum sealant performance.

   a. Type B (bi-cellular) or Type C (closed cell), non-gassing foam, as recommended by sealant manufacturer for use with each sealant type and location.

2. Elastomeric Tubing Sealant Backing: Neoprene, butyl or EPDM tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to minus 26 degrees F. Furnish products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and contribute to producing optimum sealant performance.

2.03 ACCESSORIES

A. Primer

Types recommended and furnished by joint sealant manufacturer and as required based on results of preconstruction field adhesion testing for adhesion of sealant to joint substrates shown on the Contract Drawings.

B. Bond Breaker Tape

Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (third) surface of joints. Furnish self-adhesive tape where applicable. Duct tape is not acceptable.

C. Masking Tape

Removable, nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

D. Cleaners for Nonporous Surfaces

Nonstaining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials that is not harmful to substrates and adjacent nonporous materials.

E. Vent Tubes (Weep Holes)

Heat-bendable clear acrylic or polypropylene tubes, of proper diameter and approved by the sealant manufacturer, where shown on the Contract Drawings and as required to direct moisture to the outside of the building.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect joints shown on the Contract Drawings to receive joint sealants for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not allow joint sealant Work to proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints

Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), oil, grease, waterproofing, water repellents, water, surface dirt and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with joint sealants. Remove loose particles remaining after cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form oil or release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and similar nonporous joint substrate surfaces with chemical cleaners or by other means that are not harmful to substrates and that do not leave residue capable of interfering with adhesion of joint sealants.

B. Joint Priming

Prime joint substrates where recommended by joint sealant manufacturer and where required based on results of preconstruction field adhesion testing. Apply primer and allow to cure in compliance with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking

Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

A. General

Comply with joint sealant manufacturer's printed installation instructions and recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions shown on the Contract Drawings.

B. Sealant Backings

1. Install sealant backing of type shown on the Contract Drawings, or if not shown, in accordance 3.03 A, for support of sealants during application. Install sealant backing in position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths to allow optimum sealant movement capability.

   a. Do not leave gaps between ends of sealant backings.

   b. Do not stretch, twist, puncture or tear sealant backings.

   c. Remove absorbent sealant backings that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants and sealant backings, joint fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

3. Install compressible seals serving as sealant backings to comply with requirements of 3.03 B.1 for sealant backings.

C. Sealants

Follow sealant manufacturer's installation instructions so that installed sealants directly contact and fully wet joint substrates, completely fill recesses provided for each joint configuration and provide uniform, cross-sectional shapes and depths relative to joint widths to allow optimum sealant movement capability.

D. Tooling

1. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint.

2. Do not use tooling agents that discolor sealants or adjacent surfaces, or tooling agents that are not approved by sealant manufacturer.

3. Joint Configuration: Concave per ASTM C 1193, Figure 8A, unless otherwise shown on the Contract Drawings to be flush per Figure 8B or to be recessed per Figure 8C.

   a. Recessed joint depth shall be as shown on the Contract Drawings. Use masking tape to protect adjacent surfaces of recessed, tooled joints.

E. Clean off excess sealants or sealant smears adjacent to joints immediately as Work progresses by methods and with cleaning materials approved by manufacturer of joint sealant.

3.04 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of issuance of the Certificate of Final Completion.

B. If despite such protection, damage or deterioration occurs, including bubbling, cut out and remove damaged or deteriorated joint sealants and backings immediately and reseal joints with new materials to produce joint sealant installations with repaired areas indistinguishable from original Work, at no cost to the Authority.

END OF SECTION

SECTION 07920

SEALANTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

07920C01 When color sealant is required, submit two separate bead sample strips of manufacturer's standard colors showing full range of colors available and sample strips of colors to match adjacent mortar color, for each product exposed to view.

Product Data

07920D01 Manufacturer's product data for each joint sealant product, sealant backing, primer and accessory required, and instructions for joint preparation and sealant application.

Certificates

07920E01 From joint sealant manufacturer attesting that its sealant products comply with 1.03 A-B and 2.02 A.1 and 2 as applicable, and that their sealant products are suitable for the use shown on the Contract Drawings.

Manufacturer Test Reports

07920F01 Compatibility and adhesion test reports from sealant manufacturer indicating that materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance, and sealant manufacturer's recommendations for primers and substrate preparation needed to obtain adhesion.

Qualifications

07920K01 Evidence of installer's experience and capabilities. Include lists of completed projects with project names and addresses, names and addresses of architects and owners and other information specified.

Inspection Reports

07920O01 Preconstruction field adhesion test report results per 1.03 C when field adhesion tests are

directed by the Engineer.

END OF APPENDIX "A"

07920

DIVISION 8

SECTION 08110

CUSTOM HOLLOW METAL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for custom hollow metal Work for doors, frames and related openings; and metal panels and louvers installed therein.

B. Building in of anchors and grouting of frames in masonry construction, if any, is specified in a Division 4 Section of these Specifications.

C. Finish hardware installation for doors is specified in the Section of these Specifications entitled "Finish Hardware".

D. Glazing, if any, of Work of this Section is specified in another Division 8 Section of these Specifications.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Nationals Standards Institute, Inc. (ANSI)
ANSI A 115	Series Door and Frame Preparation
	American Society for Testing and Materials (ASTM)
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A366	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
ASTM A525	General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process
ASTM A526	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A569	Steel, Carbon (0.15 maximum percent), Hot-rolled Sheet and Strip, Commercial Quality
ASTM B117	Method of Salt Spray (Fog) Testing
ASTM C236	Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM E90	Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

ASTM E152	Methods for Fire Tests of Door Assemblies
ASTM E413	Classification for Determination of Sound Transmission Class
ASTM F476	Test Methods for Security of Swinging Door Assemblies

Door and Hardware Institute (DHI)

Recommended Locations for Builders Hardware for Custom Steel Doors and Frames

National Fire Protection Association (NFPA)

NFPA 80	Fire Doors and Windows

Steel Structures Painting Council (SSPC)

SSPC - PT-2	Cold Phosphate Surface Treatment
SSPC - PT-4	Hot Phosphate Surface Treatment

Underwriters Laboratories, Inc. (UL)

Building Materials Directory

1.03 QUALITY ASSURANCE

A. All materials for Work of this Section shall be from a single manufacturer.

B. Entities performing installation Work of this Section shall have not less than 5 years experience in installation of hollow metal doors, frames and associated fabrications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal Work in cartons or crates to provide protection during transit and storage at the construction site. Inspect hollow metal Work upon delivery for damage. Field repair minor damage provided refinished items are equal in all respects to new Work and acceptable to the Engineer; otherwise, remove and replace items.

B. Store doors and frames at the construction site under cover. Place units on minimum 4-inch high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create a humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

1.05 DESIGN AND PERFORMANCE REQUIREMENTS

A. Material final assembly is to be located within a 500mile radius of the project site.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. The assembly which the hollow metal doors were manufactured shall be in accordance with the material proximity section of Division 1 Sustainability Requirements.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements specified in this Section, provide products assembled within 500 miles from the project location of one of the following or approved equal:

A. Hollow Metal and Thermal Rated Doors, Frames and Panels

Gensteel Doors, St. Laurent, Quebec, Canada

B. Sound Rated Door and Frame Assemblies

Gensteel Doors, St. Laurent, Quebec, Canada

C. Fire Rated Door and Frame

Gensteel Doors, St. Laurent, Quebec, CanadaIA

2.02 MATERIALS

A. Provide the following, where shown on the Contract Drawings.

1. Interior Hollow Metal Doors, Panels and Frames Commercial quality, cold rolled carbon steel conforming to ASTM A366; or hot rolled, commercial quality carbon steel, pickled and oiled conforming to ASTM A569. Commercial-quality stainless steel, AISI Type 304, complying with ASTM A167, exposed finish No. 4.

2. Exterior Hollow Metal Doors, Panels and Frames

Commercial quality zinc-coated carbon steel conforming to ASTM A526 with ASTM A525, G 90, zinc coating, mill phosphatized. Commercial-quality stainless steel, AISI Type 316L, complying with ASTM A167, exposed finish No. 4.

B. Insulating Material for Hollow Material Doors

Fiberglass, mineral wool, urethane, or similar type material, approved by the Engineer, resistant to fire, vermin, mildew and rot to meet requirements of 2.03 D, E and F of this Section. Provide required cores for fire-rated doors.

C. Supports and Anchors

Fabricate of not less than 16 gage sheet metal. For units to be built into exterior walls, galvanize after fabrication in conformance with ASTM A153, Class B.

D. Inserts, Bolts and Fasteners

Manufacturer's standard units, except hot-dip galvanize those items to be built into exterior walls in conformance with ASTM A153, Class C or D, as applicable.

E. Shop Applied Prime Paint

Baked-on-rust inhibiting prime paint capable of passing a 500 hour salt spray and 1000 hour humidity test in accordance with ASTM B117 as certified by an independent laboratory and suitable as base for finish paint as specified in Section 09910 of these Specifications. Do not prime surfaces of stainless steel, if any.

2.03 CONSTRUCTION FEATURES

A. Provide hollow metal doors which have been pretested and certified by the manufacturer to conform to ASTM F476 Door Impact Test, Grade 40, Table X5.1.

B. Fire Rated Door Assemblies

Where fire-rated door assemblies are shown on the Contract Drawings, provide fire-rated door and frame assemblies that comply with NFPA No. 80; and have been tested, listed and labeled in accordance with ASTM E152 by UL or other independent testing, inspection and labeling agency approved by the Engineer.

C. Oversize Fire-Rated Door Assemblies

For door assemblies required by the Contract Drawings to be fire-rated and exceeding sizes of tested assemblies, provide certificate of label construction from UL or other independent testing and inspection agency approved by the Engineer, indicating that door and frame assembly conforms to the requirements of design, materials and construction as established by individual listings for tested assemblies.

D. Temperature Rise Rating

For stairwell enclosure doors shown on the Contract Drawings, provide doors which have a temperature rise rating of 450 degrees F maximum in 30 minutes of fire exposure.

E. Sound Rated (Acoustical) Assemblies

Where acoustical doors are shown on the Contract Drawings, provide door and frame assemblies which have been fabricated as sound-reducing type, tested in accordance with ASTM E90 and STC classified in accordance with ASTM E413. Unless otherwise shown on the Contract Drawings, provide acoustical assemblies with sound ratings of STC 33 or better.

F. Thermal-Rate (Insulating) Assemblies

For exterior doors and other locations where shown on the Contract Drawings, provide hollow metal doors which have been fabricated as thermal insulating units and tested in accordance with ASTM C236.

1. Unless otherwise shown on the Contract Drawings, provide unit "U-value" rating of 0.24 BTU/hr./sq. ft./degree F, or better.

2.04 FABRICATION

A. General

1. Fabricate hollow metal units rigid and free from defects, warps or buckles. Accurately form metal to sizes and profiles shown on the Contract Drawings. Factory fit and assemble units where possible. Identify Work that cannot be permanently factory assembled before shipment and provide required connector splines or plates to assure proper assembly at the construction site. Weld exposed joints continuously; grind and make smooth, flush and invisible. Do not use metallic filler to conceal manufacturing defects.

2. Fasteners

Unless otherwise shown on the Contract Drawings, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

B. Finish Hardware Preparation

1. Prepare hollow metal doors and frames to receive mortised and concealed finish hardware including cutouts, reinforcing, drilling and tapping in accordance with approved finish hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications.

2. Reinforce hollow metal units to receive surface-applied hardware. At the Contractor's option, drilling and tapping for surface-applied finish hardware may be done at the construction site.

3. Unless otherwise shown on the Contract Drawings, locate finish hardware in accordance with "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" published by DHI.

C. Shop Painting (except at stainless steel doors and frames)

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.

2. Apply pretreatment to cleaned metal surfaces using cold phosphate solution (SSPG-PT-2) or hot phosphate solution (SSPC-PT-4).

3. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer.

   a. Full immersion dip coat on frames.

   b. Smooth, even, full coverage spray coat on doors, panels and louvers to a uniform dry film thickness of not less than 2.0 mils.

D. Doors and Panels

1. Unless otherwise shown on the Contract Drawings, provide flush design doors 1 3/4 inch thick, fully welded seamless construction. Provide hollow metal panels, if any, of same materials, construction and finish as hollow metal doors.

   a. Interior Doors: Minimum 18 gage face sheets

   b. Exterior Doors: Minimum 16 gage face sheets

   c. For single-acting swing doors, bevel vertical edge 1/8 inch in 2 inches. For double-acting swing doors, round vertical meeting edge with 2 1/8 inch radius.

2. Reinforce inside of doors with continuous vertical formed steel sections not less than 22 gage spaced 6 inches o.c. Spot weld at not more then 5 inches o.c. to both face sheets.

3. Reinforce tops and bottoms of doors with 16 gage horizontal steel channels welded continuously to outer sheets. At exterior doors, close top and bottom edges with additional 16 gage steel channels as integral part of door construction to provide weather seal. Provide weep hole openings in door bottoms to permit escape of entrapped moisture.

4. Unless otherwise required for acoustical or thermal assemblies, provide filler of fiberboard, mineral wool board or other insulating material solidly packed to the full door height, to fill voids between inner core reinforcing members.

5. Fit non-fire-rated hollow metal doors in their respective frames, with the following clearances:

   a. Jambs and head: 1/8 inch

   b. Meeting edges, pairs of doors: 1/8 inch

   c. Bottom: 3/8 inch, where no threshold or carpet

   d. Bottom: 1/8 inch, at threshold or carpet

6. Fit fire-rated doors with clearances as specified in NFPA 80.

7. Stainless Steel Doors

Stainless Steel doors shall be fabricated of single sheets of stainless steel, gage as specified above, with seamless construction and honeycomb cores. Provide labeled stainless steel door assemblies, in the required fire ratings - where fire-rated assemblies are shown. Provide #4 polish on exposed surfaces with vertical grain direction unless shown otherwise.

a. Reinforce tops and bottoms of doors with stainless steel 16 gage, horizontal channels, welded continuously to core faces. For exterior stainless steel doors, close top and bottom edges to provide weather seal.

E. Frames

1. Provide hollow metal frames for doors, transoms, side-lights and other openings as shown on the Contract Drawings.

2. Fabricate frames of full-welded unit construction with corners mitered, reinforced and continuously welded the full depth and width of frame. Terminate bottom of frames at finished floor surface. Knock-down type frames are not permitted.

a. Interior openings: Minimum 16 gauge

b. Exterior openings: Minimum 14 gauge

c. For openings over 4 feet wide, provide continuous 12-gauge steel channel stiffener for full width of opening, welded to back of frame at head.

3. Provide removable spreader bar across bottom of frames, tack weld to jambs and mullions.

4. Except on interior doors listed in Section 08715 Appendix "A" Finish Hardware Schedule of these Specifications to receive acoustic, weather or smoke seals, drill stop in frame strike jamb to receive 3 silencers on single-door frames and drill frame head stop to receive 2 silencers on double-door frames. Install plastic plugs to keep holes clear until installation of silencers.

5. Provide 26 gage steel plaster guards welded to frame at back of hardware mortise on frames to be set in mortar or plaster construction.

6. Mullions and Transom Bars

Provide closed or tubular mullions and transom bars where shown on the Contract Drawings. Reinforce joints between frame members with concealed clip angles of same metal thickness as frame. At removable units provide exposed fasteners; at fixed units, fasten by butt welding.

7. Form frames of stainless steel sheets with #4 polish for openings indicated to receive stainless steel doors, gage as specified above.

F. Frame Anchors

1. Floor Anchor

Provide 14 gage galvanized steel sheet clip anchor welded to jambs, with 2 holes to receive fasteners and provision for 2 inch height and adjustment.

2. Jamb Anchors

a. Masonry construction

Adjustable, flat, corrugated or perforated, T-shaped to suit frame size, with leg not less than 2 inches wide by 10 inches long. Furnish minimum 3 anchors per jamb up to 7 feet - 6 inches high; 5 anchors for greater than 7 feet - 6 inches and up to 8 feet - 0 inches; over 8 feet - 0 inches one additional anchor for each 24 inches or part thereof.

b. Metal stud partitions

Insert type with notched clip to engage stud, welded to back of frames. Provide at least 4 anchors each jamb up to 7 feet - 6 inches height; 5 anchors for greater than 7 feet - 6 inches and up to 8 feet - 0 inches; over 8 feet - 0 inches one additional anchor for each 24 inches or part thereof.

c. In-place concrete or masonry

Anchor jambs with a minimum 3/8-inch concealed bolts into expansion shield or inserts at 6 inches from top and bottom and 26 inches o.c.

G. Finish Hardware Reinforcement

1. Reinforce doors and frames for required finish hardware as follows:

a. Hinges and Pivots

Steel plate 3/16 inch thick by 1 1/2 inch wide; 6 inches longer than hinge or pivot, secured by not less than 6 spot-welds.

b. Mortise Locksets and Dead Bolts: 14 gauge steel sheet, secured with not less than 2 spot-welds.

c. Strike plate clips: Steel plate 3/16 inch thick by 1 1/2 inch wide by 3 inches long.

d. Flush Bolts: 12 gauge steel sheet, secured with not less than 2 spot-welds.

e. Surface-Applied Closers and Coordinators

12-gauge steel sheet, secured with not less than 6-spot welds. Provide reinforcement for surface closers on all doors and frames.

f. Concealed Closers

Removable steel access plate, 12-gauge internal reinforcement of size and shape required, and enclosing housing to keep closer pocket free of mortar or other materials.

g. Push Plates and Grab Bars

16-gauge steel sheet (except when sex screws are scheduled), secured with not less than 2 spot welds.

h. Surface Panic Devices

14-gauge sheet steel (except when sex screws are scheduled), secured with not less than 2 spot welds.

H. Door Louvers

1. Unless otherwise shown on Contract Drawings, for interior doors provide sightproof, stationary type of inverted V-shaped blades formed of 18 gage cold-rolled steel. Prime painted after fabrication - except for stainless steel doors (where shown on the Contract Drawings). At stainless steel doors, provide 18 gage stainless steel blades, finish to match door.

2. For fire-rated doors, provide tightly fitted, spring-loaded automatic closing louvers with operable blades retained by fusible links. Rating label shall be the same as door units.

3. Mount louvers flush into doors without overlapping moldings on surface of door facing sheets.

I. Louvered Panels

1. Provide for installation in hollow metal or stainless steel frames, where shown on the Contract Drawings.

2. Interior

Not less than 18-gauge cold-rolled steel sheet, sightproof inverted V-shaped blades and U-shaped frames. Space blades not more than 3 inches o.c. with internal support as required. Assemble units by welding. Prime paint after fabrication - except for panels in stainless steel frames. Panels in stainless steel frames shall be constructed of 18 gage stainless sheet, finish to match frame.

3. Exterior

Not less than 16 gage galvanized steel sheet, stationary, weatherproof Z-shaped blades and U-shaped frames. Space blades not more than 1-1/2 inches o.c. with internal support as required. Provide removable 14 x 18-inch bronze wire mesh insect screens on interior side of frame with rigid formed galvanized steel frame surround - except for panels in stainless steel frames. Panels in stainless steel frames shall be constructed of 16 gage stainless sheet, finish to match frame.

J. Transom Panels

1. Provide for installation in hollow metal or stainless steel frames, where shown on the Contract Drawings.

2. Interior

Not less than 18 gage cold-rolled steel, prime painted after fabrication - except for transoms in stainless steel frames. Panels in stainless steel frames shall be constructed of 18 gage stainless sheet, finish to match frame.

3. Exterior

Not less than 16 gage cold-rolled steel, prime painted after fabrication - except for transoms in stainless steel frames. Panels in stainless steel frames shall be constructed of 16 gage stainless sheet, finish to match frame.

K. Astragals

Install Z-shape on double-door active leaf 3/4-inch x 1-3/4-inch wide, 12-gauge. Furnish with countersunk holes located at 12 inches o.c., fastened with flat head machine screws. Weld fill screw heads after installation and grind smooth. Tack welding may be substituted for machine screws.

L. Vision Panel

Minimum 20-gauge glazing stops with butt corner joints, flush with face of door or frame, secured with countersunk tamperproof machine screws spaced at a maximum of 8 inches on centers on security side of door or frame.

PART 3. EXECUTION

3.01 PREPARATION

Prior to frame installation, clean damaged areas of prime coat and apply touch-up of compatible air-drying primer at surfaces which will be concealed.

3.02 INSTALLATION

A. Install in accordance with approved shop drawings, manufacturer's data and as specified in this Section.

B. Provide anchorage devices where required for securing hollow metal frames to in-place construction. Use drilled-in anchorage devices and machine screws. Do not set floor anchors with powder-actuated fasteners.

C. Placing Frames

1. Set in position shown on the Contract Drawings, plumbed, aligned and braced until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
2. Place frames at fire-rated openings in accordance with NFPA 80.
3. Grout solid all door frames shown to be installed in CMU walls and partitiions.
4. Make field splices in frames, if any, as detailed on approved shop drawings. Weld and finish to match shop Work.

D. Door Installation: Maintain door clearances in accordance with 2.04 D.5 and D.6 of this Section.

3.03 FIELD ADJUSTMENTS

A. Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Check and readjust operating finish hardware items. Remove and replace doors or frames which are warped, bowed or otherwise unacceptable to the Engineer.

C. Stainless Steel Touch-Up

Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION

SECTION 08110

CUSTOM HOLLOW METAL

APPENDIX "A"

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

1. Shop Drawings

   Include details of each frame type, elevation of door design, types, hardware reinforcement, details of construction, anchorage details, and door schedules covering doors and frames using same opening reference number shown on the Contract Drawings.

2. Samples:

   a. Door

      One 1 foot 0 inch x 1 foot 0 inch corner section with hinge mortise and reinforcement showing internal construction.

   b. Frame

      One 1 foot 0 inch x 1 foot 0 inch corner section showing welded joint of head to jamb. Include hinge mortise, reinforcement and plaster guard in one rabbet.

   c. Samples submitted shall be of the production type and represent the quality of Work to be installed.

B. Certifications

1. Evidence of installer qualifications as required by 1.03 of this Section.
2. Laboratory certification of prime paint, as required by 2.02 E this Section.
3. Evidence of assembly location for all Doors and Frames
4. Certification of the following as required by 2.03 of this Section.

   a. Door impact test
   b. Oversize fire-rated door assemblies, if any
   c. Sound transmission class (STC), if any
   d. Insulating (U-value), if any

C. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein.

Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).
      2) The assembling location of the supplied product(s)
      3) The location (source) of the raw materials used to manufacture the supplied product(s).
      4) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.
2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.
4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).
5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 8

SECTION 08330

OVERHEAD COILING DOORS AND FIRE DOORS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for complete operating overhead coiling door assemblies, including insulated overhead doors and overhead fire doors.

B. Electrical connections for powered operators, if any, are specified in Division 16 of these Specifications.

1.02 REFERENCES

A. The following is a listing of the publications referenced in this Section:

1. American Society for Testing and Materials (ASTM)

ASTM A 36	Carbon Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 653	Single Sheet Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 152	Methods of Fire Tests of Door Assemblies

2. National Fire Protection Association (NFPA)

   a. NFPA 80 Standard for Fire Doors and Windows

   b. For electrically operated doors:

      (1) NFPA 70 National Electric Code

      (2) NFPA 72 National Fire Alarm Code

3. Underwriters Laboratories (UL)

UL 217	Single and Multiple Station Smoke Detectors
UL 325	Door, Drapery, Gate Louver, and Window Operators and Systems

4. National Electrical Manufacturers Association (NEMA)

NEMA ICS 1	General Standards for Industrial Control and Systems
NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	Enclosures for Industrial Controllers and Systems
NEMA MG 1	Motors and Generators

1.03 QUALITY ASSURANCE

Furnish each overhead coiling door, including hardware, accessories, mounting and installation components, as a complete unit produced by one manufacturer unless otherwise approved by the Engineer.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Wind Loading

Exterior overhead coiling doors shall be constructed to withstand wind loading pressure, as required by applicable codes.

B. Deflection along the spindle shall not exceed 1/360 x the span of the door or applicable code requirements--whichever is more stringent.

C. Maximum opening sizes of overhead coiling doors and fire doors as listed in the manufacturer's printed literature, shall not be exceeded.

D. Doors shall be designed and constructed in such a manner that possible vibration in supporting structure will not cause the door to close.

E. Fire Door Assemblies

Where shown on the Contract Drawings, furnish fire door assemblies which comply with NFPA No. 80 and have been fire tested, rated and labeled by UL. Furnish each door with a metal UL label indicating rating in hours of duration of exposure to fire and letter designation of location for which assembly is designed.

1. Oversize Fire Doors

Where fire door assemblies shown on the Contract Drawings exceed size for which UL testing and labeling service is offered, furnish a UL "Certificate of Inspection" for oversize doors, in lieu of label, certifying that design, materials and construction are at least equivalent to UL Standard size door requirements.

2. Automatic Closing

On all door assemblies provide an automatic closing device and governor, which operates when activated by temperature rise and melting of 160 degree F fusible link. Construct governor unit to be inoperative during normal door operations. Design release mechanism for easy resetting.

3. Where shown on the Contract Drawings, provide UL labeled ionization type smoke detectors, electromechanical door holder release devices and necessary mounting brackets in accordance with UL 217. Fabricate such door units to permit manual lifting of curtain for emergency exit after automatic closing, with curtain returning to closed position when released.

1.05 SUBMITTALS

For Submittal requirements see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide products of one of the following, or approved equal:

Cornell Iron Works Inc., Mountaintop, PA

J. G. Wilson Corp., Norfolk, VA

McKeon Rolling Steel Door Co., Brooklyn, NY

2.02 MATERIALS

A. Door Curtain

Fabricate overhead door curtain of interlocking slats designed to withstand required wind loading, of continuous length for width of door without splices. Unless shown otherwise on the Contract Drawings, provide slats of gage recommended by door manufacturer for size and type of door required, but not less than 22 gage for un-insulated doors fabricated of structural quality, cold-rolled galvanized steel sheets with G90 zinc coating, complying with ASTM A 653, and phosphate treated before fabrication.

B. Endlocks

Malleable iron casting galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats.

C. Windlocks

Malleable iron castings secured to curtain with galvanized rivets. Unless otherwise recommended by door manufacturer, provide windlocks on exterior doors exceeding 16 feet wide. Space windlocks approximately 24 inches o.c. on both edges of curtain.

D. Bottom Bar

Consisting of 2 angles, each not less than 1 1/2 inch x 1-1/2 inch x 1/8 inch thick, galvanized.

E. For manually operated doors provide a replaceable gasket of flexible vinyl or neoprene between angles as a weather seal and cushion floor bumper.

F. Curtain Jamb Guides

Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build-up units with minimum 3/16-inch thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

1. Secure continuous wall angle to wall framing by 3/8-inch minimum bolts at not more than 30 inches o.c., unless closer spacing is recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless shown otherwise on the Contract Drawings. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain, and continuous bar for holding windlocks.

G. Vision Panels (if any)

Panels shall consist of 1/4 inch thick (minimum), cast thermoplastic, methyl methacrylate flat glazing sheet with smooth mirror finish as shown on the Contract Drawings. Set panels in neoprene or vinyl glazing channel, secured in curtain slats.

H. Weather Seals

Vinyl or neoprene weather-stripping for exterior exposed doors. At door heads, use 1/8-inch thick continuous sheet secured to inside of curtain coil hood. At doorjambs, use 1/8-inch thick continuous strip secured to exterior side of jamb guide.

I. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and mounted in a spring barrel and connected to door curtain with barrel rings as required by the manufacturer. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

J. Counterbalance Barrel

Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll-up of curtain without distortion of slats and limit barrel defection to not more than 0.03 inch per ft. of span under full load.

K. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

L. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold fixed spring ends and carry torsional load.

M. Brackets

Provide mounting brackets of manufacturer's standard design, either cast iron or cold--rolled steel plate with bell mouth guide groove for curtain.

N. Hood

Form to entirely enclose coiled curtain and operating mechanism at opening head, and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

1. Fabricate steel hoods for doors of not less than 24 gage hot-dip galvanized steel sheet with G 90 zinc coating, complying with ASTM A 653. Phosphate-treat before fabrication.

O. Provide sheet metal protective enclosures for main gear and motor assembly: form to entirely enclose main gear, spring adjuster, and motor assembly (where applicable), with a removable enclosure. Frame out with steel bars or angles, ASTM A 36, hot-dip galvanized in accordance with ASTM A 123. Fabricate enclosure panels of hot-dip galvanized steel as specified in Paragraph 2.02 N. above. Leave gap for chain and other moving items that may protrude. Provide access panels for easy accessibility for servicing. For exterior applications, the metal enclosure shall be weather tight, with vinyl or neoprene gaskets.

2.03 CONSTRUCTION FEATURES

A. Manual Doors

Provide manual operators as shown on the Contract Drawings except where electric door operators are shown otherwise:

1. Manual Push-Up Operation

Provide counter-balance mechanism so that required lift or pull for door operation does not exceed 25 lb. Adjust operating mechanism so that curtain can be easily stopped at any point in its travel and to remain in position until movement is resumed.

a. Provide galvanized steel lifting handle and slide bolt lock on inside bottom bar.

2. Chain Hoist Operator

Provide manual chain hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and geared reduction unit with maximum 35 lb. pull for door operation. Design chain hoist with self-locking mechanism allowing curtain to be stopped at any point in its travel and to remain in position until movement is resumed. Furnish alloy steel hand chain with chain holder secured to operator guide.

3. Crank Hoist Operator

Provide crank hoist operator consisting of crank and crank gear box, steel crank drive shaft and gear reduction unit. Size gear to require no more than 25-lb. effort to turn crank. Fabricate gearbox to completely enclose operating mechanism and be oil-tight. Design unit so that curtain may be stopped at any point in its travel and to remain in position until movement is resumed. Provide manufacturer's standard crank locking device.

B. Electric Door Operators

1. Where shown on the Contract Drawings, provide electric door operator in accordance with the following:

a. Assembly conforming to NEMA Standards ICS1, ICS2, ICS6 and MG1;

b. Approved in accordance with UL 217 and UL 325, of size and capacity recommended and provided by door manufacturer;

c. Complete with electric motor and factory-prewired motor controls, gear reduction unit, solenoid operated brake, remote control stations, control devices, conduit and wiring from controls to motor and central stations in accordance with Division 16 of these Specifications; and

d. Accessories required for proper operation.

2. Provide Auto-Set Fire Door Model FSFD, as manufactured by McKeon Rolling Steel Door Co., or M-100 Fire Guard System, as manufactured by Cornell Iron Works, or approved equal.

3. Provide hand-operated disconnect or a mechanism for automatically engaging a sprocket and chain operator and releasing brake for emergency manual operation. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

4. Provide operator that will enable motor to be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

5. Coordinate electric door operators with the requirements of 1.04 E of this Section.

6. Door Operator Type

   Provide wall or bracket-mounted door operator units conforming to NEMA requirements, consisting of electric motor, worm gear drive from motor to reduction gear box, chain or worm gear drive from reduction box to gear wheel mounted on counterbalance shaft, and a disconnect-release for manual operation.

7. Electric Motors

   High-starting torque, reversible, constant duty, class A insulated electric motors with overload protection, sized to move door in either direction, from any position, at not less than 2/3 foot nor more than 1 foot per second.

   a. Unless shown otherwise on the Contract Drawings provide open-drip proof type motor and controller with NEMA Type I enclosure.

   b. Where shown on the Contract Drawings provide totally enclosed, nonventilated type motors, fitted with plugged drain, and controller with NEMA Type 4 enclosure.

8. Remote Control Station

   Provide momentary-contact, 3-button control station with push button controls labeled "Open", "Close" and "Stop".

   a. Interior units, full-guarded, surface-mounted heavy-duty, with general purpose NEMA Type 1 enclosure.

   b. Exterior units, full-guarded type, standard duty, surface-mounted, weatherproof type, NEMA Type 4 enclosure, key-operated.

9. Automatic Reversing Control

   Furnish each door with electrically actuated automatic safety switch, extending full width of door bottom, and located within bottom door rail. Contact with switch before fully closing will immediately stop downward travel and reverse direction to fully opened position. Connect to control circuit through retracting safety cord and reel, or self-coiling cable.

10. Provide automatic reset feature, controlled rate of decent, and internal governors.

C. Where exterior overhead coiling doors are shown on the Contract Drawings, provide an insulated system, with interior and exterior facing sheets and a non-combustible core insulation of R value shown on the Contract Drawings or as required by code.

2.04 SHOP FINISHING

A. Finish the door assemblies with one of the following systems, where shown on the Contract Drawings:

1. Shop clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except faying and lubricated surfaces, with rust inhibitive primer, which is compatible with finish painting, if any, as specified in Division 9 Section on painting.

2. Galvanized steel slats, bottom bars, guides, miscellaneous enclosure panels, and hoods shall receive a baked-on minimum 0.8-mil thick polyester topcoat over a minimum 0.2-mil thick epoxy primer.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts hangers, and equipment supports in accordance with approved shop drawings, manufacturer's instruction, and as specified in this Section.

B. Install fire-rated doors, where shown on the Contract Drawings, in accordance with NFPA 80.

C. Install electrically operated doors in accordance with NFPA 70 and 72.

3.02 FIELD TESTS

A. Upon completion of installation including associated Work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and which fit weathertight for entire perimeter.

B. On door assemblies, test door closing when activated by operation of smoke detector fire release system and/or fusible link. Reset door-closing mechanism after successful test.

END OF SECTION

SECTION 08330

OVERHEAD COILING DOORS AND FIRE DOORS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

08330A01 Shop drawings for components and installations, which are not fully dimensioned or detailed on the manufacturer's data sheets. Include sheet metal protective enclosures for main gear and motor, if any.

Product Data

08330D01 Manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead coiling door. Provide operating instructions and maintenance information, and complete information describing fire-release system including electrical rough-in instructions.

Certificates

08330E01 UL certification for oversize fire-rated doors and frames certifying that each assembly has been constructed with materials and methods equivalent to UL requirements.

END OF APPENDIX "A"

DIVISION 8

SECTION 08715

FINISH HARDWARE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for finish hardware for doors scheduled in Appendix "B".

B. Establish keying, furnish keys and key control system in accordance with Keying Appendix "C".

C. If required by Appendix "D", furnish extra stock and specialized tools and maintenance instructions.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American National Standards Institute, Inc. (ANSI)/Builders Hardware Manufacturers Association, Inc. (BHMA)

A 156.1	Butts and Hinges.
A 156.2	Locks and Lock Trim.
A 156.3	Exit Devices.
A 156.4	Door Controls – Closers.
A 156.5	Auxiliary Locks.
A 156.7	Template Hinge Dimensions.
A 156.8	Door Controls - Overhead Holders.
A 156.13	Mortise Locks and Latches.
A 156.14	Sliding and Folding Door Hardware.
A 156.18	Materials and Finishes.
A 117.1	Providing Accessibility and Usability of Physically Handicapped People.

Underwriters Laboratories Inc. (UL)

	Building Materials Directory.
UL10C	Positive Pressure Fire Tests of Door Assemblies
UL 228	Door Closers-Holders, With or Without Integral Smoke Detectors.
UL 437	Key Locks.

National Fire Protection Association (NFPA)

Standard No. 80 - Fire Doors and Windows.

Door and Hardware Institute (DHI)

Recommended Locations for Builders Hardware for Custom Steel Doors and Frames.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Fire Rated Openings

Provide hardware for fire-rated openings in compliance with NFPA No. 80 which has been tested and listed by UL Building Materials Directory or other nationally recognized independent testing, inspection and labeling agencies acceptable to the Engineer.

B. Detectable Warnings

Provide doors shown on the Contract Drawings leading to potential hazardous locations such as boiler rooms and loading docks that are accessible to the public, with textured surface hardware conforming to requirements of ANSI A 117.1, and as scheduled in Appendix "B".

C. Closers and Holders

Conform to requirements of ANSI A 156.4, Grade 1, and ANSI A 156.8 respectively.

1. Where door(s) shown on the Contract Drawings are required to be accessible to the physically handicapped and are scheduled in Appendix "B" to receive manual closer(s), provide adjustable unit(s) complying with ANSI A 117.1 provisions for door opening force and delayed action.

D. Furnish and mount electro-magnetic door holder(s) where shown on the Contract Drawings or scheduled in Appendix "B". Electrical connections for such item(s), if any, are specified in Division 16 Section(s) of these Specifications.

1. Provide integral smoke detector device in combination door closers and holders complying with UL 228.

E. Exit Devices

Conform to requirements of ANSI A 156.3 Grade 1. Where emergency exit devices are required on fire rated door(s), provide exit devices available as a complete series, listed in UL "Accident Equipment List - Panic Hardware" and bearing the designation "Fire Exit Hardware".

F. Locks

Conform to the following ANSI Standards, provide 5/8 inch minimum throw on pairs of non-fire-rated doors and 3/4 inch minimum throw on pairs of fire-rated doors:

1. Mortise Locks and Latches: A 15, Grade 1.
2. Cylindrical Locks and Latches: A 156.2, Grade 1.

G. Cylinders

Conform to the requirements of ANSI A 156.5 Grade 1, UL listed, and tested for drill and pick resistance requirements of UL 437.

H. Strikes

Manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set. Provide dust-proof strikes for foot-bolts, except where threshold provides non-recessed strike for bolt.

I. Sliding and Folding Door Hardware: Conform to ANSI A 15.

J. Template Hinges

Conform to ANSI A 156.1 and A 156.7. All hinges shall be full-mortise type, ball-bearing function, unless otherwise indicated on Hardware Schedule Appendix "B".

K. Materials and Finish

Conform to ANSI A 156.18, do not furnish products of Type 0 "optional" materials or forming methods. Provide matching finishes for hardware units at each door or opening to the greatest extent possible. Reduce color and texture differences as much as commercially possible.

1.04 QUALITY ASSURANCE

A. The entity performing Work of this Section shall have a minimum of 5 years of experience involving quantities and complexities at least equal to those required for the Work of this Section, and shall employ an architectural hardware consultant who shall be available for consultation at the construction site if requested by the Engineer.

B. Provide instruction for the management of the key control system, if any, as required by 1.04 of Appendix "C".

C. Manufacturers for various products are listed in Finish Hardware Schedule Appendix "B". Except as otherwise shown on Appendix "B", products of equivalent quality, design and function by other manufacturers may be used subject to approval of the Engineer in accordance with 1.06 A hereof.

1. Provide each type of hardware (latch and locksets, mortise locks, mortise cylinders, hinges, closers, or other items) from a single manufacturer.

2. Where finish hardware provided as Work of this Section is to be installed within an existing Authority facility, provide such items from the same manufacturer as presently installed, unless otherwise shown on Appendix "B".

1.05 DELIVERY, STORAGE, AND HANDLING

A. Tag or package each item separately, with identification related hardware schedule required in 1.06 B.1 set number. Include manufacturer's basic installation instructions with each item or package.

B. Pack and deliver all locks and cylinders less keys.

C. Provide secure lock-up for hardware delivered to the construction site, but not yet installed. Provide controlled handling and installation of hardware until issuance of the Certificate of Final Completion.

D. Deliver keys as required by Appendix "C".

E. If extra stock is required by Appendix "D", deliver materials to the Engineer in accordance with 1.05 A and B hereof; and deliver keys in accordance with Appendix "C" hereof.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Finish hardware manufacturers, or approved equal, are listed in Appendix "B".

B. Key control system manufacturers, if required by 1.04 of Appendix "C", as follows:

Best Lock Corp., Indianapolis, IN
Telke Inc., Glen Riddle, PA
Key Control Systems Inc., Bechtelsville, PA

2.02 MATERIALS

Provide hardware conforming to Appendix "B" and requirements of 1.03.

2.03 CONSTRUCTION FEATURES

A. Provide hardware for machine screw installation. Do not provide hardware prepared for self-tapping sheet metal screws, unless specifically scheduled otherwise in Appendix "B".

B. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws unless specifically scheduled otherwise in Appendix "B". Finish exposed screws (exposed under any condition) to match hardware finish or, if exposed in surfaces of other Work, to match finish of such other Work, including "Prepared for Paint" on surfaces to receive paint finish.

C. Provide concealed fasteners for hardware units that are exposed when door is closed. Do not use through bolts; provide set screw fastener.

D. Hinges

Provide stainless steel pins on non-ferrous hinges, steel pins on steel hinges; non-removable at exterior and out-swinging corridor doors, non-rising for interior non-security exposure, flat button with matching plugs.

E. Power Transfer Devices

Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ or approved equal standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

Electric Door Hardware Cords: Provide electric transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

F. Closers

1. Section Provide parallel arms, unless otherwise scheduled in Appendix "B".

2. No corner mounting brackets permitted.

3. Mount closers on interior of building, and within stairwells. Where parallel arm closers are scheduled at exterior doors in Appendix "B", provide units one size larger than manufacturer's recommendations for standard arm units.

G. Electromechanical Locking Devices

1. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

a. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.

H. Provide coordinator device for pairs of doors equipped with closers and astragal; prepared for vertical rod exit device.

I. Provide metal threshold unit of type, size and profile as shown on the Contract Drawings or scheduled on Appendix "B". Include butyl rubber or polyisobutylene mastic sealant for exterior doors.

J. Provide resilient silencers for all interior metal doorframes, 3 per single doorframe, 2 per double doorframe (head of frame), unless acoustic or smoke seal is scheduled on Appendix "B".

K. Provide protection plates where scheduled on Appendix "B", sized as follows:

1. Armor plates: 36 inches high.

2. Mop plates: 4 inches high.

3. Kick plates: 8 inches high.

4. Kick plates for barrier free doors: 16 inches high.

5. Width: 1-1/2 inches less than door opening on doorstop side; 1/2 inch less than door opening opposite stop side.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install each hardware item in compliance with the manufacturer's instructions. Unless otherwise shown on the Contract Drawings, locate in accordance with DHI "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames".

B. Coordinate installation, removal, storage and reinstallation of items with finishing Work specified in Division 9 Section(s) of these Specifications.

C. Set hardware units level, plumb and true to line and location.

D. Drill and countersink units that are not factory-prepared for anchorage fasteners.

E. Set exterior door threshold in full bed of mastic sealant to completely exclude moisture.

3.02 ADJUSTING

A. Check and adjust each hardware item and each door. Ensure proper operation. Replace operating units that cannot be adjusted to operate freely and smoothly.

B. Adjust door control devices to compensate for operation of heating and ventilating equipment.

C. Clean hardware and adjacent surfaces.

END OF SECTION

SECTION 08715

FINISH HARDWARE

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Submit a finish hardware data sheet listing manufacturers of finish hardware to be furnished and installed as Work of this Section.

B. Samples

Concurrent with submittal of Appendix "B", submit one sample of each type of hardware unit, tagged with full description. Samples shall be retained by and become the property of the Authority.

C. Schedules

1. Hardware Schedule

Based on the manufacturers approved in accordance with 1.06 A. Organize schedule by hardware sets and include the following:

a. Name and manufacturer of each item.

b. Type, style function, size and finish of each item.

c. Location of hardware set cross referenced to Contract Drawing door opening numbers.

d. Door and frame sizes, and materials.

e. Wiring diagrams of electronic hardware items.

f. Explanation of all abbreviations, codes and symbols contained in schedule.

g. UL label designation.

2. Keying Schedule shall be in accordance with 1.02 of Appendix "C".

D. Quality Assurance

Submit templates to each fabricator of doors and frames as required for preparation to receive hardware. Submit to the Engineer notification of such transmittals to door fabricator(s).

E. Spare Parts List

If required by Appendix "D", submit extra stock and one complete set of specialized tools for maintenance to the Engineer in accordance with 1.05 E.

END OF APPENDIX "A"

SECTION 08715

APPENDIX "B"

FINISH HARDWARE SCHEDULE

The following schedule contains a listing of hardware for each door (and roof hatch and locker, if any) by set number which corresponds with hardware set number shown on the Contract Drawings.

*Denotes manufacturers scheduled for Work of this Section, or approved equal.

**Denotes manufacturers scheduled for Work of this Section, with no substitution permitted.

Item	Manufacturer	Symbol
Locks/Latches	Best	B
	Corbin*	C
	Yale	Y
Cylinders	Best**	B
	Corbin	C
	Yale	Y
Electromechanical Locking Devices	Corbin	C
	Best	B
	Yale	Y
Butts/Hinges	Hager	H
	McKinney*	MC
	Stanley	ST
Exit/Panic Devices	Corbin*	C
	Yale	Y
	Von Duprin	VD
Door Bolts	Builders Brass Works	BW
	Ives	I
	Stanley	ST
Overhead Closers	Corbin*	C
	LCN	LCN
	Yale	Y
Smoke-activated Closures	Corbin	C
	Dorma	D
	Rixon Firemark	RF
Floor Closers	Door O Matic	DM
	Dorma	D
	Rixon Firemark	RF
Overhead Stop	Corbin*	C
	Glynn-Johnson	GJ
	Rixon Firemark	RF
Door Stripping, Drop Seal & Threshold, Astragal	A.J. May	M
	Pemko*	P
	Zero	Z

Silencers	Builders Brass Works	BW
	Ives*	I
	Quality	Q
Push/Pull Units and Protection Plates	Builders Brass Works	BW
	Tremco	T
	Quality Hardware Co.	QH
Sliding/Bi-fold Hardware Sets	Grant	GR
	Lawrence	LA
	Stanley	ST
Door Trim/Stops	Builders Brass Works	BW
	Glynn-Johnson	GJ
	Ives	I

HARDWARE SETS

HW1 [101A, 103B, 201, 202, 301A, 303B, 401, 402, 501A, 501B, 502]

#	Item	Model #	Finish	Man uf.
2	Hinge	Per spec section 2.03 E	US32D	MC
1	Electrified Hinge	Per spec section 2.03 E x QC12	US32D	MC
1	Electric Exit Device (rim, fail safe)	ED5200 A9903 M92 M110	630	C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC5240	689	C
1	Threshold	2548A		P
1	Gasketing	S88BL		P
1	Sweep	18061CNB		P
1	Door Contact	See Electronics Contract Drawings		
2	Card Reader	See Electronics Contract Drawings		
1	ElectroLynx Harness - Door	See Electronics Contract Drawings		
1	Wiring Diagram	See Electronics Contract Drawings		
1	Power Supply	See Electronics Contract Drawings		

Notes:

1. Operation

   Pull Side: Upon presenting valid credentials electrified trim will unlock allowing entry. Trim will re-lock after entry. Upon loss of power, trim will unlock (Fail Safe)

   Push Side: Always free egress. Presenting valid credentials will shunt signal to security system. When panic bar is depressed and no valid credential has been presented, signal will be sent to security system to sound alarm (M92).

HW2 [101B, 102B, 105B, 301B, 302B, 305B]

#	Item	Model #	Finish	Man uf.
4	Hinge	Per spec section 2.03 E	US32D	MC
2	Electrified Hinge	Per spec section 2.03 E x QC12	US32D	MC
1	Electric Exit Device (surface vertical rod, fail safe)	ED5470 A9903 H0702 M92 M55 M110	630	C
1	Electric Exit Device (surface vertical rod, storeroom)	ED5470 A959 H0702 M92 M55 M110		C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC5240	689	C
1	Threshold	2548A		P
1	Gasketing	S88BL		P
2	Sweep	18061CNB		P
1	Astragal	18041CNB		P
1	Door Contact	See Electronics Contract Drawings		
2	Card Reader	See Electronics Contract Drawings		
1	ElectroLynx Harness - Door	See Electronics Contract Drawings		
1	Wiring Diagram	See Electronics Contract Drawings		
1	Power Supply	See Electronics Contract Drawings		

Notes:

1. Operation

Pull Side: Active Leaf: Upon presenting valid credentials electrified trim will unlock allowing entry. Trim will re-lock after entry. Upon loss of power, trim will unlock (Fail Safe) Inactive Leaf: Trim always locked. Entry by turning key, will relock once key is removed

Push Side: Always Free egress. Presenting valid credentials will shunt signal to security system. When panic bar is depressed and no valid credential has been presented, signal will be sent to security system to sound alarm (M92).

HW3 [102A, 103A, 105A, 302A, 303A, 305A]

#	Item	Model #	Finish	Man uf.
2	Hinge	Per spec section 2.03 E	US32D	MC
1	Electrified Hinge	Per spec section 2.03 E x QC12	US32D	MC
1	Electric Exit Device (surface vertical rod, fail safe)	ED5200A A9903 M92 M55 M110	630	C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC8210	689	C
1	Door Stop	As required	689	C
1	Threshold	2548A		P
1	Gasketing	S88BL		P
1	Door Contact	See Electronics Contract Drawings		
2	Card Reader	See Electronics Contract Drawings		
1	ElectroLynx Harness - Door	See Electronics Contract Drawings		
1	Wiring Diagram	See Electronics Contract Drawings		
1	Power Supply	See Electronics Contract Drawings		

Notes:

1. Operation

Pull Side: Upon presenting valid credentials electrified trim will unlock allowing entry. Trim will re-lock after entry. Upon loss of power, trim will unlock (Fail Safe)

Push Side: Always Free egress. Presenting valid credentials will shunt signal to security system. When panic bar is depressed and no valid credential has been presented, signal will be sent to security system to sound alarm (M92).

HW4 [104, 107, 304, 307]

#	Item	Model #	Finish	Man uf.
2	Hinge	Per spec section 2.03 E	US32D	MC
1	Electrified Hinge	Per spec section 2.03 E x QC12	US32D	MC
1	Electrified Mortise Lock	ML 20903 ASM M92 LC	630	C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC8210	689	C
1	Door Stop	As required	689	C
1	Threshold	2548A		P
1	Gasketing	S88BL		P
1	Door Contact	See Electronics Contract Drawings		
2	Card Reader	See Electronics Contract Drawings		
1	ElectroLynx Harness - Door	See Electronics Contract Drawings		
1	Wiring Diagram	See Electronics Contract Drawings		
1	Power Supply	See Electronics Contract Drawings		

Notes:

1. Operation

Corridor Side: Upon presenting valid credentials electrified trim will unlock allowing entry. Trim will re-lock after entry. Upon loss of power, trim will unlock (Fail Safe)

Push Side: Always Free egress. Presenting valid credentials will shunt signal to security system. When no valid credential has been presented, signal will be sent to security system to sound alarm (M92).

HW5 [106, 306]

#	Item	Model #	Finish	Man uf.
4	Hinge	Per spec section 2.03 E	US32D	MC
2	Electrified Hinge	Per spec section 2.03 E x QC12	US32D	MC
1	Exit Device (surface vertical rod, fail safe)	ED5470B A9903 H0702 M92 M55 M110	630	C
1	Exit Device (surface vertical rod, storeroom)	ED5470B A959 H0702 M92 M55 M110	630	C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC8210	689	C
1	Gasketing	S88BL		P
1	Door Contact	See Electronics Contract Drawings		
2	Card Reader	See Electronics Contract Drawings		
1	ElectroLynx Harness - Door	See Electronics Contract Drawings		
1	Wiring Diagram	See Electronics Contract Drawings		
1	Power Supply	See Electronics Contract Drawings		

Notes:

1. Operation

Pull Side: Active Leaf: Upon presenting valid credentials electrified trim will unlock, allowing entry. Trim will re-lock after entry. Upon loss of power, trim will unlock (Fail Safe) Inactive Leaf: Trim always locked. Entry by turning key, will relock once key is removed

Push Side: Always Free egress. Presenting valid credentials will shunt signal to security system. When panic bar is depressed and no valid credential has been presented, signal will be sent to security system to sound alarm (M92).

HW6 [108, 308]

#	Item	Model #	Finish	Man uf.
3	Hinge	Per spec section 2.03 E	630	MC
1	Mortise Lock	ML 2057 ASM LC	US32D	C
1	Cylinder	1E Interchangable IC removable core 7 pin	US32D	B
1	Closer (surface)	DC8210 A3	689	C
1	Gasketing	S88BL		P
1	Door Contact	See Electronics Contract Drawings		

END OF APPENDIX "B"

SECTION 08715

APPENDIX "C"

1.01 Construction Key System

A. Construction key system is not required.

1.02 Keying System

A. General: Meet with the Engineer and the facility manager to finalize keying requirements and obtain final instructions in writing.

1. Submit detailed keying schedule as required by Appendix "A" C.2 of this Specification Section to indicate final keying of locks. Provide the following:

a. Keying system schematic diagram and floor plan(s) with corresponding key symbols indicated for each door.

b. Copy of final keying schedule as transmitted to lock manufacturer.

c. When keying is an extension of an existing system, include all references and registry numbers of existing keying.

B. Provide integrated keying system, with the existing BEST key system.

C. Mark the keying symbol on key bow only.

1.03 Keys

A. Key Material: Nickel silver, without substitution.

B. Not Used

C. Key Quantity: Deliver the following keys from the lock manufacturer to the Engineer via registered mail.

1. Prior to construction site delivery of finish hardware items:

a. 4 changed keys/lock.

b. 20 of each master key, grandmaster key or great-grandmaster key.

2. *Prior to issuance of the Certificate of Final Completion, 0 control keys for initial* construction

1.04 Key Control System

A. A key control system is not required.

END OF APPENDIX "C"

SECTION 08715

APPENDIX "D"

MAINTENANCE PROVISIONS

1.01 Extra Stock

A. Furnish, and deliver to the Engineer in accordance with 1.05 E., the following extra stock of finish hardware items with extra mounting screws for each item:

1. 10 lock(s) with cylinders for door(s).
2. 10 latches for door(s).
3. 10 overhead closers for doors(s).

B. Specialized tools are not required.

END OF APPENDIX "D"

DIVISION 8

SECTION 08955

TRANSLUCENT FIBERGLASS SKYLIGHTS AND WALL PANELS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies translucent fiberglass skylight and wall panel systems, including aluminum framing, flashing and trim.

B. Attachment to structural steel framing is specified in this Section. For steel framing for skylights and wall panels see Division 5 Sections of these specifications on structural steel and/or miscellaneous steel framing and supports.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI A 58.1	Minimum Design Loads for Buildings and Other Structures.
	American Society of Civil Engineers (ASCE)
ASCE 7	Minimum Design Loads for Buildings and Other Structures.
	American Society for Testing and Materials (ASTM)
ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B211	Specification for Aluminum Alloy Bars, Rods and Wire.
ASTM B221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
ASTM B316	Aluminum and Aluminum-Alloy Rivets and Cold-Heading Wire and Rods.
ASTM C297	Tension Test of Flat Sandwich Construction in Flat-Wise Plane.
ASTM D1002	Strength Properties of Adhesives in Shear by Tension Loading.
ASTM D1037	Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
ASTM D3841	Specification for Glass-Fiber-Reinforced Polyester Plastic Panels.
ASTM E283	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

ASTM E330	Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
ASTM E331	Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

American Welding Society (AWS)

AWS D 1.1	Structural Welding Code, Steel.
AWS D 1.2	Structural Welding Code, Aluminum.

Steel Structures Painting Council (SSPC)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Performance Requirements

Provide wall panel assemblies that comply with specified performance characteristics. Test panel assemblies of equal or greater size than those shown on the Contract Drawings by a recognized testing laboratory or agency in accordance with specified test methods. Submit certified test results in accordance with Appendix "A".

B. Thermal Movement

Provide systems capable of withstanding thermal movements resulting from a temperature range of 180 degrees F within the framing system. Provide thermal calculations for skylight and wall panel system, signed and sealed by a professional engineer licensed in the state where the Work is to be erected.

C. Wind Loading

Provide panel assemblies capable of withstanding a uniform inward and outward test pressure when tested in accordance with ASTM E330, Procedure A. The panel assemblies shall be tested for a minimum wind pressure of 50 psf. Provide structural calculations for skylight and wall panel system, including attachments to building structure, signed and sealed by a professional engineer licensed in the state where the Work is to be erected.

1. Deflection and Structural Tests

No skylight or wall panel framing member shall deflect, in a direction normal to the plane of the roof or wall surface to which panels are attached, more than 1/40 of its clear span or 3/4 inch, whichever is less, when tested in accordance with ASTM E330. No panel shall have a permanent deformation in excess of 0.5 percent of its clear span when tested in accordance with ASTM E330 for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified in 1.03 C herein.

D. Transmission Characteristics

Provide wall panel systems that comply with requirements specified below for transmission characteristics.

1. Air Infiltration

Provide systems with an air infiltration rate of not more than 0.01 CFM per sq. ft. of fixed area when tested in accordance with ASTM E283 at an inward test pressure differential of 6.24 psf.

2. Water Penetration

Provide systems with no water penetration as defined in the test method when tested in accordance with ASTM E331 at an inward test pressure differential of 15 lb. per sq. ft.

E. Erection Tolerances

Design and erect wall system to accommodate tolerances in building frame and other contiguous Work as follows:

1. Maximum variation from plane or location shown on approved shop drawings shall be 1/8 inch per 12 feet of length up to but not more than 1/2 inch in any total length.
2. Maximum offset from true alignment between two identical members abutting end to end in line shall be 1/16 inch.

F. All water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, shall be drained to exterior.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Field Measurements

Check openings by field measurement before fabrication to ensure proper fitting of Work. Show field measurements on shop drawings.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications

Provide skylight and wall panel systems produced by a single manufacturer with not less than 5 years experience, or who employs personnel with not less than 5 years experience, in the manufacture of assemblies of an equal or greater complexity than those required for Work of this Section.

B. Installer's Qualifications

Wall panel systems shall be installed by an entity that has not less than 5 years experience, or which employs personnel who have not less than 5 years experience, in the installation of systems of an equal or greater complexity than those required for Work of this Section.

C. Mock-ups

Prior to installation of skylight and wall panel system, prepare mock-ups of skylight and wall panel system using system components, where directed by the Engineer. Sizes of mock-ups shall be as shown on the Contract Drawings. Do not proceed with skylight and wall panel installation until mock-ups are approved by the Engineer. Acceptable mock-ups may be incorporated in the Work.

1. Once approved, all future skylight and wall panels shall match the mock-ups such that no visual difference in color or texture can be detected in the finished units.

1.06 DELIVERY, STORAGE, AND HANDLING

Deliver units in the manufacturer's original, unopened packages, fully identified with type, finish, performance data, and compliance labels. Handle and store in accordance with the manufacturer's printed instructions and recommendations.

1.07 SUBMITTALS

A. See Appendix "A" for submittal requirements.

1.08 GUARANTY

A. Notwithstanding the Specifications forming a part of this Contract, any inspection or approval of the Work by the Authority, or the existence of any patent or trade name, the Contractor nevertheless unconditionally guarantees that the skylight and wall panel system shall be of the best quality and shall be fully fit for the purpose for which it is intended. The Contractor unconditionally guarantees all system components furnished and installed under this Contract against defects or failures of any kind, including defects or failures in design, workmanship and materials, including excessive leakage or air infiltration, faulty operation, and deterioration of metal, metal finishes, fiberglass panels and their protective coatings, and other materials beyond normal weathering, except such defects or failures which the Contractor demonstrates to the satisfaction of the Engineer have arisen solely from accident, abuse or fault of the Authority, occurring after issuance of the Certificate of Final Completion for this Contract and not due to fault on the Contractor's part, for a period of three years from the issuance of such Certificate. In the event of defects or failures in skylight and wall panel systems, upon receipt of notice thereof from the Engineer, the Contractor shall correct such defects or failures by immediately repairing or replacing the affected Work as may be necessary or desirable in the sole opinion of the Engineer to comply with the above guaranty. The foregoing guaranty shall not, however, be a limitation on any rights which the Authority would have, either expressed or implied, in connection with this Contract in the absence of such guaranty, in the case of a breach of Contract by the Contractor, the said guaranty being given only or the greater assurance of the Authority.

B. The Contractor shall have the skylight and wall panel manufacturer furnish its written guaranty, prior to the issuance of Certificate of Final Completion, against weathering or discoloration of more than 15 percent, fiberbloom, or delamination of the surface coating of the exterior sheet, including aluminum surfaces, for a period of ten (10) years.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products of one of the following, or approved equal:

Kalwall Corporation, Tel (800) 258-9777 – Fax: (603) 627-7905 – Email: info@kalwall.com
Structures Unlimited, Inc., Manchester, NH
Major Industries, Inc., Wausau, WI

2.02 MATERIALS

A. Aluminum Members

Frames and blades shall be manufactured of commercial quality 6063-T6 extruded aluminum conforming to ASTM B221.

B. Fiberglass Reinforced Polymer: Comply with ASTM D3841, Grade 1.

C. Wall Panel System Gaskets and Joint Fillers

Manufacturer's standard permanent type gaskets and joint fillers, depending on joint movement and sealing requirements, such as sliding joints, compression joint translation or non-moving joints.

D. Brackets and Reinforcements

Manufacturer's standard high-strength aluminum items, where feasible; otherwise provide non-magnetic stainless steel. At the fabricator's option, brackets for anchorage to structure and not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A123. Provide non-staining, non-ferrous shims for installation and alignment of Work.

E. Fasteners and Accessories

1. Manufacturer's standard non-corrosive fasteners and accessories that are compatible with materials used in the skylight and wall panel system and with exposed portions that match finish of the panels. Where movement should be expected, provide slip-joint linings of sheets, pads, shims or washers of fluorocarbon resin or a similar material recommended by the manufacturer.

2. Items for bolting aluminum extrusions and connecting members: Stainless steel complying with ASTM A193, Series 300; aluminum complying with ASTM B211, alloy 2024 T-5; or aluminum rivets complying with ASTM B316, unless otherwise recommended by the skylight and wall panel system manufacturer.

3. Items for anchoring skylight and wall panel system to supporting structure: Zinc-coated steel fasteners complying with ASTM A307.

4. Where fasteners anchor into aluminum less than 0.125-inch thick, provide non-corrosive pressed-in splined grommet nuts or other type reinforcement to receive fastener threads.

F. Concealed Flashing

Where shown on the Contract Drawings, provide .015" aluminum, unless otherwise shown on the Contract Drawings.

G. Exposed Flashing and Closures

Dead-soft stainless steel flashing complying with ASTM A167, Series 304: minimum 0.018 inch (24 gauge) thick; or aluminum sheet, complying with ASTM B209, alloy and temper 5005-H34 or 1100-H14, minimum 0.060 inch thickness, where shown on the Contract Drawings.

H. Welding Electrodes and Filler Metal

Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS D1.1 or D1.2 requirements and as required for strength and compatibility in the fabricated items.

I. Use filler metals and welding procedures that will blend with and match the color of sheet metal being joined and will avoid discoloration at welds.

2.03 CONSTRUCTION FEATURES

A. Panels shall be 4 inch thick, consisting of two fiberglass reinforced polymer sheets adhesively bonded to a mechanically interlocked thermally brokengrid core. Unless otherwise shown on the Contract Drawings, panels shall have flush mullions to accept structural supports.

1. Tensile strength of adhesive bond shall be 750 psi as tested in accordance with ASTM C297 before and after two exposures to six cycles each of the aging conditions prescribed by ASTM D1037.

2. Minimum shear strength of the panel adhesive by ASTM D1002 after exposure to four separate conditions:

   a. 50% Relative Humidity at 68° F: 540 PSI

   b. 182° F: 100 PSI

   c. Accelerated Aging by ASTM D1037 at room temperature: 800 PSI

   d. Accelerated Aging by ASTM D1037 at 182° F: 250 PSI

B. Panel cavity shall have no glass fiber type insulation and achieve rated "U" value of 0.55, light transmission value of 20%, and solar heat gain coefficient of 0.38.

C. Screen pattern (formed by thermally broken I-beam grid) shall be Reverse Shoji, 20" x 8" nominal panel grid. Visible panel grids shall be equally subdivided within sightline openings between frame and mullion elements.

D. Closure system: Thermally broken extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system. Thermally broken panels: Minimum Condensation Resistance Factor of 8- by AAMA 1503 measured on the bond line. Sealing tape shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

E. Treat all dissimilar metals contacting aluminum and steel materials with bituminous paint or otherwise separate to avoid adverse reactions such as material degradation due to electrolytic action.

F. Appearance

1. The face sheets shall be uniform in color to prevent splotchy appearance. Faces shall be completely free of ridges and wrinkles that prevent proper surface contact in bonding to the aluminum grid core. Clusters of air bubbles/pinholes that collect moisture and dirt will not be acceptable.

2. Exterior face sheets shall be 0.070 inch thick, color to match approved samples and mock-ups. Interior face sheets shall be 0.045 inch thick, color to match approved samples and mock-ups. Faces shall not vary more than ±10 percent in thickness.

3. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.

2.04 SHOP PAINTING

A. General

Apply coatings either before or after forming and fabricating panels, as required by coating process, and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed. Provide colors or color matches shown on the Contract Drawings, or if not shown, as selected by the Engineer from the manufacturer's standard color chart.

B. High Performance Organic Coating

AA C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals, prepared with an acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Ensure that coating is applied in strict accordance with coating manufacturer's instructions by a licensed applicator.

1. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene resin by weight; complying with AAMA 2605. Color and gloss as shown on Contract Drawings.

2. Subject to compliance with requirements, fluoropolymer coating systems shall contain resins produced by Atofina Chemicals, Inc. ("Kynar 500") or Solvay Solexis, Inc. ("Hylar 5000").

3. Furnish manufacturer's written warranty covering failure of the fluoropolymer coating system for a period of twenty (20) years after the date of Final Completion.

PART 3. EXECUTION

3.01 PREPARATION

Prepare openings including isolating dissimilar materials from aluminum system which may cause damage by electrolysis, as specified herein.

3.02 ERECTION

A. Install translucent skylight and wall panel system in strict accordance with approved shop drawings. All aluminum shall be cleaned before sealants are applied.

B. Use method of attachment to structure permitting sufficient adjustment to accommodate construction tolerances and irregularities.

C. Provide alignment attachments and shims required to permanently fasten system to building structure.

D. Align assembly free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent construction.

E. Coordinate attachment and seal of air and vapor barrier materials. Install flashings, if any.

F. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

G. Welding

Where field welding is required or permissible in concealed locations use only Gas Tungsten Arc Welding (TIG) or Gas Metal Arc Welding (MIG) process. Take care to protect exposed finishes.

H. Perimeter Sealants and Joint Fillers

Install weathering sealant at connections of skylight and wall panel system to other materials as specified in the Section of Division 7 of these Specifications concerning joint sealers.

3.03 ADJUSTMENTS

After other adjacent Work has been completed, carefully inspect translucent panel installation and make adjustments necessary to ensure proper installation and weather-tight conditions.

3.04 CLEANING

A. After erection of skylight and wall panel system and completion of flashing and joint treatment and when other Work had been substantially completed remove protective materials from prefinished aluminum surfaces.

B. Where exposed surfaces are soiled, they shall be washed down using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer. Use materials non-harmful to panels.

D. Demonstrate proper cleaning methods and materials to the Authority's maintenance personnel.

END OF SECTION

SECTION 08955

TRANSLUCENT FIBERGLASS SKYLIGHTS AND WALL PANELS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product specifications, technical product data, standard details, and instructions for application, installation, cleaning and maintenance for each type of skylight and wall panel system product required. Include the following information:

1. Fabrication methods.
2. Finishes.
3. Storage and handling instructions.
4. Accessories.
5. Light transmittance and "U" values of panels.

B. Shop Drawings

Show fabrication and installation details of skylight and wall panel system including the following information:

1. Elevations, minimum acceptable scale: 1/2 inch = 1 foot.
2. Detail sections of typical composite members, minimum acceptable scale: 3 inches = 1 foot.
3. Anchorages and reinforcements.
4. Expansion provisions.
5. Gutter and flashing details, minimum acceptable scale: 3 inches = 1 foot.

C. Samples

1. Submit pairs of samples of each type and color of aluminum finish, on 12-inch long sections of extrusions or formed shapes and on 6-inch square sheets. Where color or texture variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of variations.
2. Submit samples approximately 12" x 24" full thickness of panel for each type of fiberglass panel shown on the Contract Drawings with respect to screen pattern, color range, texture of surface finishes, and light transmittance values illustrating same.

D. Certifications

Provide certified test results showing that skylight and wall panel system have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics, under 1.03 and 2.03 A.

E. Design Calculations

1. Thermal calculations, as required by 1.03 B.
2. Structural calculations, as required by 1.03 C.

F. Qualifications

Qualification data for entities specified in 1.05 A and 1.05 B to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of architects and owners, and other information specified.

END OF APPENDIX "A"

DIVISION 9

SECTION 09250

GYPSUM DRYWALL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for interior non-load-bearing steel framing, interior gypsum board assemblies and finishing, and cementitious backer units installed with gypsum board assemblies.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI A 108.11	Specifications for Interior Installation of Cementitious Backer Units.
ANSI A 118.9	Test Methods and Specifications for Cementitious Backer Units.
	American Society for Testing and Materials (ASTM)
ASTM A 653	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM C 473	Test Methods for Physical Testing of Gypsum Panel Products.
ASTM C 475	Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
ASTM C 645	Specification for Nonstructural Steel Framing Members.
ASTM C 665	Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
ASTM C 754	Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
ASTM C 834	Specification for Latex Sealants.
ASTM C 840	Specification for Application and Finishing of Gypsum Board.
ASTM C 919	Practice for Use of Sealants in Acoustical Applications.
ASTM C 954	Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
ASTM C 1002	Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
ASTM C 1047	Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
ASTM C 1177	Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

ASTM C 1178	Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
ASTM C 1396	Specification for Gypsum Board.
ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 3273	Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
ASTM E 90	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
ASTM E 119	Test Methods for Fire Tests of Building Construction and Materials.
ASTM E 413	Classification for Rating Sound Insulation.
	Gypsum Association (GA)
GA-216	Specifications for the Application and Finishing of Gypsum Board.
GA-600	Fire Resistance Design Manual.
	Underwriters Laboratories Inc. (UL)
	Fire Resistance Directory.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings

Where gypsum drywall assemblies with fire-resistance ratings are shown on the Contract Drawings, installed assemblies shall be identical to those indicated by reference to GA File Numbers in GA-600 or to design designations in UL's *Fire Resistance Directory*, tested per ASTM E 119.

B. Sound Transmission Ratings

Where gypsum drywall assemblies with sound transmission ratings (STC rated) are shown on the Contract Drawings, installed assemblies shall be identical to those tested per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing agency, and identical to those assemblies where indicated by reference to GA File Numbers in GA-600.

1.04 ENVIRONMENTAL REQUIREMENTS

A. General

Comply with the following ASTM C 840 requirements for environmental conditions before, during and after application of gypsum board:

1. Room Temperatures

For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and for finishing of gypsum board, maintain not less than 50 deg F for 48 hours before application and continuously after until dry. Do not exceed 95 deg F room temperature when using temporary heat sources.

2. Ventilation

Ventilate building spaces as required to remove excess water for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too-rapid drying.

B. Install gypsum drywall products after installation areas are enclosed and meet requirements of 1.04 A.1 and 2.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility

1. Obtain steel framing members for gypsum board assemblies from a single manufacturer.

2. Obtain each type of gypsum board and other panel products, including joint treatment materials, from a single manufacturer.

3. Obtain trim accessories from either the same manufacturer that supplies gypsum board or from a manufacturer acceptable to gypsum board manufacturer.

B. Mock-ups

Prior to finishing gypsum board assemblies, prepare field mock-up for review and acceptance by the Engineer. Mock-ups shall demonstrate qualities of materials and execution. Mock-ups accepted by the Engineer may be incorporated into the finished Work.

1. Prepare mock-ups of the following:

a. Exposed Locations: Each level of gypsum board finish in accordance with 3.03 H.

2. Mock-up Size: Minimum 100 sq. ft. in surface area.

3. Simulate finished lighting conditions for review of in-place Work to receive a Level 4 or 5 finish.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside, under cover and in a manner to keep them dry, protected from weather, freezing, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect trim accessories from being bent or damaged.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements, furnish and install products by one of the following, or approved equal:

A. Non-Load-Bearing Steel Framing and Accessories

Clark Steel Framing Systems, Middletown, OH
Deitrich Metal Framing, Inc., div. of Worthington Industries Co., Pittsburgh, PA
Marino\WARE, South Plainfield, NJ
Super Stud Building Products, Inc., Astoria, NY

B. Gypsum Board and Related Products

BPB America Inc., Tampa, FL
G-P Gypsum Corp., Atlanta, GA
National Gypsum Co., Charlotte, NC
United States Gypsum Co., Chicago, IL

2.02 MATERIALS

A. Wall/Partition Framing Materials

1. General

Sizes and spacing of steel framing members shall be as shown on the Contract Drawings, but not less stringent than required to comply with ASTM C 754 under the following deflection and uniform lateral loading conditions:

a. Maximum Deflection: L/240 at 5 lbf per square foot; except L/360 at 5 lbf per square foot where framing supports panels products finished with tile, stone, lath, plaster or similar inflexible materials.

b. Material: Corrosion resistant steel complying with ASTM C 645; 0.0179 inch minimum base metal thickness (25 gage), unless otherwise required for abuse-resistant assemblies or other special purposes shown on the Contract Drawings.

c. Protective Coating: G40 hot-dip galvanized per ASTM A 653, unless otherwise specified.

2. Steel Studs and Runners (Track)

a. Studs: ASTM C 645; size (web depth) as shown on the Contract Drawings.

b. Runners (Track): ASTM C 645; match studs.

(1) Deflection Track: 0.0312 inch minimum base metal thickness (20 gage) with 2 inch flanges, for use as top runner abutting underside of floor construction where double runner is shown on the Contract Drawings.

3. System Accessories

a. Steel Rigid Furring Channels

Hat-Shaped Channel: ASTM C 645.

b. Steel Resilient Furring Channels

Manufacturer's standard product designed to reduce sound transmission through wall partitions and ceilings; 1/2 inch deep channel of configuration shown on the Contract Drawings.

c. Cold-Rolled Furring Channels

U-shaped channel; 0.0538 inch minimum base metal thickness (16 gage), minimum 1/2 inch wide flanges; of depth as shown on the Contract Drawings.

d. Furring Brackets

Serrated-arm type, adjustable; 0.0329 inch minimum base metal thickness (20 gage), designed for screw attachment of steel studs used for furring and steel rigid furring channels to interior side of exterior masonry walls.

e. Z-Furring Members

Z-shaped channel for attachment of gypsum board to concrete or masonry walls; G60 hot-dip galvanized coating per ASTM A 653; of depth required to accommodate insulation of thickness shown on the Contract Drawings.

f. Flat Strap and Backing Plate

Manufacturer's standard sheet steel products for blocking and bracing, in lengths and widths as shown on the Contract Drawings.

B. Gypsum Board

1. General

Type, thickness and edge configuration as indicated below, for use where shown on the Contract Drawings, in maximum lengths available to minimize end-to-end butt joints.

a. Thickness: As shown on the Contract Drawings.

b. Edges: Tapered and featured (rounded or beveled) for prefilling.

c. Gypsum board used as backing board or in multi-layer applications shall be board type as shown on the Contract Drawings, 5/8 inch thick, unless otherwise shown, with square, non-tapered or V-tongue and groove edges.

2. Regular Gypsum Wallboard: ASTM C 1396.

3. Type X: ASTM C 1396; for use in fire-resistant rated assemblies and where shown.

4. Special Type X: ASTM C 1396; with improved fire protection qualities over standard Type X, for use in fire-resistant rated assemblies and where shown.

5. Flexible Type: ASTM C 1396; more flexible than regular gypsum wallboard, 1/4 inch thick, for forming curved walls.

6. Water-Resistant Gypsum Backing Board: ASTM C 1396, core type as required by fire-resistance rated assembly indicated.

7. Moisture- and Mold-Resistant Type: ASTM C 1396, or ASTM C 1396 and ASTM C 1177; for use at interior of exterior walls and where shown, with Type X core where required or where shown; ASTM C 473 average water absorption maximum of 5 percent by weight after 2 hour immersion; ASTM D 3273 mold resistance average panel score minimum of 8.

   a. Products: Subject to compliance with requirements, furnish and install one of the following products, or approved equal:

      DensArmor Plus Interior Guard; G-P Gypsum Corp., Atlanta, GA
      Gold Bond XP Wallboard; National Gypsum Co., Charlotte, NC
      Humitek; United States Gypsum Co., Chicago, IL

8. Abuse-Resistant Type: ASTM C 1396; with improved resistance to surface abrasion, indentation and through-penetration impact over regular gypsum board, for use where shown, with Type X core where required or where shown.

   a. Products: Subject to compliance with requirements, furnish and install one of the following products, or approved equal:

      ToughRock Abuse-Resistant; G-P Gypsum Corp., Atlanta, GA
      Hi-Abuse; National Gypsum Co., Charlotte, NC
      Sheetrock Abuse-Resistant; United States Gypsum Co., Chicago, IL

C. Tile Backer Units

1/2 inch thick, in manufacturer's standard width but not less than 32 inches, in maximum lengths available to minimize end-to-end butt joints. Subject to compliance with requirements, furnish one of the following products, or approved equal:

1. Cementitious Backer Products: ANSI A118.9:

   WonderBoard; Custom Building Products, Seal Beach, CA
   Util-A-Crete Concrete Backer Board; FinPan, Inc., Hamilton, OH
   Hardibacker 500; James Hardie Building Products, Inc., Mission Viejo, CA
   DUROCK Brand Cement Board; United States Gypsum Co., Chicago, IL

2. Gypsum Panel Products: ASTM C 1178, or ASTM C 1178 and ASTM C 1278:

   DensShield Tile Guard; G-P Gypsum Corp., Atlanta, GA
   Fiberock Aqua-Tough; United States Gypsum Co., Chicago, IL

D. Drywall Trim Accessories

1. Cornerbead, edge trim and control joints: ASTM C 1047.

2. Materials: Formed, steel sheet zinc-coated by the hot-dip process or rolled zinc; may be fabricated in combination with paper for use with paper-faced gypsum board only.

3. Configuration: Face flanges formed to receive joint compound and as indicated by reference to accessories depicted in ASTM C 1047, Fig. 1.

E. Joint Treatment Materials

Comply with ASTM C 475 for gypsum board installation and with the recommendations of both the manufacturers of panel products and of joint treatment materials for each application shown on the Contract Drawings.

1. Joint Tape

   a. Paper-Faced Gypsum Board: Paper reinforcing tape.

   b. Glass Mat Gypsum Board: Glass mesh tape, mesh size 10 by 10.

   c. Cementitious Backer Units: Polymer-coated, alkali-resistant, open glass fiber mesh.

2. Joint Compound

   a. Setting-Type Joint Compound for Gypsum Board: Factory packaged, job-mixed, chemical-hardening powder product formulated for uses indicated.

      (1) Where setting-type joint compound is indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compound applied over it.

      (2) For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.

      (3) For filling joints and treating fasteners of moisture-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer.

      (4) For topping compound, use sandable formulation.

   b. Drying-Type Joint Compound for Gypsum Board: Factory packaged vinyl based product complying with the following requirements for formulation and intended use:

      (1) Ready-Mixed Formulation: Factory mixed product.

      (2) Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.

      (3) Topping compound formulated for fill (second) and finish (third) coats.

      (4) All-purpose compound formulated for both taping and topping compounds.

   c. Joint Compound for Glass-Mat Faced Gypsum Board: Setting type, for use with glass mesh joint tape.

   d. Joint Compound for Cementitious Backer Units: Material recommended by cementitious backer unit manufacturer.

F. Acoustical Sealant

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, skinning, paintable, nonstaining, gunnable latex sealant complying with ASTM C 834 and the following requirements:

   a. Product shall be effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by test representative assemblies per ASTM E 90.

2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.

3. Products: Subject to compliance with sound transmission and fire-resistance rating requirements, furnish and install one of the following, or approved equal:

   a. Acoustical Sealant for Exposed and Concealed Joints

      AC-20 FTR; Pecora Corp., Harleysville, PA
      Tremflex 834; Tremco Inc., Beachwood, OH
      SHEETROCK Acoustical Sealant; United States Gypsum Co., Chicago, IL

   b. Acoustical Sealant for Concealed Joints

      BA-98; Pecora Corp, Harleysville, PA
      Tremco Acoustical Sealant; Tremco Inc., Beachwood, OH
      SHEETROCK Acoustical Sealant; United States Gypsum Co., Chicago, IL

G. Miscellaneous Materials

1. Isolation Strips

   ASTM D 226, Type 1, nonperforated 15 lb. asphalt saturated organic felt, or 1/8 inch thick, adhesive-backed, closed-cell vinyl foam gasket in widths as required to suit stud size.

2. Fasteners for Steel Framing

   Type, material, size, corrosion resistance, pull-out resistance and other properties as required to fasten steel framing and furring members securely to each other and to substrates; complying with the recommendations of steel framing manufacturer for applications shown on the Contract Drawings.

3. Fasteners for Gypsum Board

   a. ASTM C 1002: Type S steel drill screws for fastening gypsum board to steel members less than 0.033 inch thick and for fastening gypsum board to gypsum board.

   b. ASTM C 954: Steel drill screws for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.

   c. For Fastening Cementitious Backer Units: Corrosion resistant coated steel drill screws of size and type recommended by unit manufacturer.

4. Laminating Adhesive

   Special adhesive or joint compound specifically recommended by gypsum board manufacturer for laminating gypsum boards.

5. Spot Grout

   ASTM C 475, setting-type joint compound recommended by joint compound manufacturer for spot-grouting hollow metal door frames.

6. Fastening Adhesive for Metal

Special adhesive recommended by gypsum board manufacturer for laminating gypsum boards to steel framing.

7. Sound Attenuation Blankets

Unfaced mineral fiber blanket insulation produced by combining mineral fibers manufactured from glass, slag or rock with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing). Comply with product flame resistance requirements where used in fire-resistance rated assemblies.

PART 3. EXECUTION

3.01 EXAMINATION

Examine substrates to which gypsum board assemblies attach or abut, including installed hollow metal frames and structural framing for compliance with requirements for installation tolerances and other conditions affecting gypsum board assembly performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed-on fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces shown on the Contract Drawings to receive sprayed-on fireproofing.

1. Where offset anchor plates are required, install continuous units formed from hot-dip galvanized steel plate of thickness shown, attached to building structure with fasteners spaced not more than 24 inches on center. Secure ceiling runners to offset plates with screws spaced not more than 24 inches on center.

3.03 INSTALLATION

A. General

1. Steel Framing Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
2. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
3. Do not bridge building expansion joints with framing system; frame both sides of joints with furring and other support as shown on the Contract Drawings.
4. Construct fire-resistance rated partitions, and column, beam, girder and truss enclosures when required, to meet or exceed the rating shown on the Contract Drawings. Protect openings, perimeters and joints
5. Construct sound transmission rated partitions, when required, to meet or exceed the STC rating shown on the Contract Drawings.

B. Wall/Partition Framing Systems Installation

1. Installation Tolerances

   Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing members.

2. Install supplementary framing, blocking and bracing at end terminations in the Work and to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings and similar items to comply with details shown or, if not otherwise shown, to comply with applicable printed recommendations of gypsum board manufacturer.

3. Where steel studs are installed directly against exterior walls, install 15 lb. asphalt felt or 1/8 inch thick foam gasket isolation strips between studs and wall.

4. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Install slip or cushioned type joints to attain lateral support and avoid axial loading.

5. Install runner tracks at floors and overhead supports.

6. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue partition framing over doors and openings, and around ducts penetrating partitions above ceiling.

7. Space studs 16 inches on center.

8. Frame door openings to comply with details shown or, if not shown, to comply with applicable written recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for jack studs) at head and secure to jamb studs. Install 2 studs at each jamb.

9. Extend vertical jamb studs through suspended ceilings and attach to underside of structural support system above or to substrates above suspended ceilings.

10. Frame openings other than door openings to comply with details shown or, if not shown, in the same manner as required for door openings or as recommended by gypsum board manufacturer. Install framing below sills of openings to match framing required above door heads.

11. Space wall furring members 16 inches on center. Fasten to concrete or masonry walls with special screws or other fasteners designed for attachment to masonry, spaced 24 inches on center.

C. Gypsum Board Installation

1. Install sound attenuation blankets, where shown on the Contract Drawings and where required for sound transmission rating, prior to installing gypsum boards unless blankets are readily installed after boards have been installed on one side of partition.

2. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

3. Locate either edge or end joints over supports. Position boards so that like edges abut; do not place tapered edges against mill-cut or field-cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

4. Install wall/partition boards vertically without horizontal end-butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

5. Locate exposed end-butt joints as far from center of walls as possible, and stagger not less than 12 inches in alternate courses of board.

6. Form control joints and expansion joints with space between edges of adjoining boards, prepared to receive trim accessories. Make only control type joints where joints occur at corners of framed openings.

7. Attach gypsum board to supplementary framing and blocking where installed for additional support at openings and cutouts.

8. Spot grout hollow metal door frames for all doors. Apply spot grout at each jamb anchor clip and immediately insert gypsum boards into frames.

9. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above finished ceiling line), except in chase walls that are braced internally.

   a. Concealed coverage may be accomplished with gypsum board pieces of not less than 8 sq. ft. in area, except where concealed application is required for sound transmission or fire ratings, or for smoke barriers.

   b. Where partitions intersect open concrete coffers, concrete joists and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum boards to fit profile formed by structural members; allow 1/4 to 3/8 inch joint width for sealant installation. Fit boards around all through penetrations...

10. Isolate perimeter of drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with J-type, semi-finishing edge trim. Seal joints with acoustical sealant.

D. Methods of Gypsum Drywall Application

1. Single-Layer Application

   a. Partitions/Walls: Apply gypsum board vertically (parallel to framing), in sheet lengths that will minimize end joints. At stairwells and other high, multistory walls, install boards horizontally.

   b. Z-Furring Members: Apply gypsum board vertically (parallel to framing) with a minimimum of end joints. Locate edge joints of base layer over furring members.

   c. Fastening Method: Apply gypsum boards to supports with screws.

2. Multilayer Application

   a. Partitions/Walls: Apply gypsum board base layers as shown on the Contract Drawings and apply gypsum board face layer vertically (parallel to framing), with joints of base layers located over stud or furring member and joints of face-layer offset at least one stud or furring member from base-layer joints. Stagger joints on opposite sides of partitions.

b. Z-Furring Members: Apply base layer vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

c. Fastening Method: Fasten base layer with screws and secure face layer with adhesive and supplementary fasteners; or fasten base and face layers separately with screws to comply with fire-resistance rated assembly requirements.

3. Wall Tile Substrates: On substrates to receive thin-set ceramic tile and similar rigid applied wall finishes, install cementitious backer units to comply with ANSI A 108.11 and install gypsum panel products to comply with manufacturer's instructions.

E. Direct-Bonding to Substrate

Comply with gypsum board manufacturer's recommendations where gypsum boards are indicated as directly adhered to a substrate (other than studs, furring members or base layer of gypsum board). Temporarily brace or fasten gypsum boards until fastening adhesive has set.

F. Acoustical Sealant Installation

Apply acoustical sealant where sound transmission rated drywall Work is shown (STC rating), including multiple-layer and resilient furring Work, in compliance with sealant manufacturer's written instructions.

1. Clean substrate surfaces by brushing and remove loose particles to produce a clean, sound substrate capable of developing optimal bond with joint sealant

2. Seal perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of beads. Close off sound-flanking paths around or through the Work, including sealing of partitions above acoustical ceilings.

3. Tool joints flush, clean excess material and allow sealant to cure per sealant manufacturer's recommendations prior to final decoration.

G. Installation of Drywall Trim Accessories

1. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Install type with face flange to receive joint compound. Install L-type trim where Work is tightly abutted to other Work.

2. For trim with flanges intended for fasteners, anchor trim with same fasteners used to attach gypsum board to framing supports. Otherwise, anchor trim flanges in accordance with gypsum board manufacturer's instructions and recommendations.

3. Install metal cornerbead at outside corners of drywall Work.

4. Install metal control joint where shown on the Contract Drawings per ASTM C 840 requirements.

H. Finishing of Gypsum Drywall

1. General

a. *Finish Level Standard:* ASTM C 840.

b. Apply compound treatment at gypsum board joints (vertical and horizontal), flanges of trim accessories, penetrations, fastener heads and elsewhere as required to prepare Work for final decoration. Prefill open joints and rounded or beveled edges, if any, using type of compound recommended by gypsum board manufacturer.

c. Apply joint tape at joints between gypsum boards using taping joint compound, except where trim accessories are shown on the Contract Drawings.

2. Finish Levels

Finish gypsum boards to the levels shown on the Contract Drawings, performed in accordance with ASTM C 840.

3.04 PROTECTION

A. Furnish protection and maintain conditions, in a manner acceptable to the Engineer, to ensure that gypsum drywall Work shall be without damage or deterioration at time of issuance of the Certificate of Final Completion.

B. Remove and replace wet or otherwise damaged board products.

END OF SECTION

SECTION 09250

GYPSUM DRYWALL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

09250D01 Manufacturer's product specifications and installation instructions for each steel framing system and gypsum drywall component, and other data showing compliance with the requirements of this Section.

Certificates

09250E01 Fire Test Response Reports: Manufacturer's certification from a qualified independent testing and inspecting agency substantiating each gypsum board assembly's required fire-resistance rating.

09250E02 Acoustic Test Response Reports: Manufacturer's certification from a qualified independent testing agency substantiating required STC rating for each gypsum board assembly.

END OF APPENDIX "A"

DIVISION 9

SECTION 09660

RESILIENT TILE FLOORING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for vinyl composition floor tile and/or homogenous (solid) vinyl floor tile, vinyl wall base and accessories.

B. Furnish extra stock in accordance with 2.02 I.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials.
ASTM E 648	Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
ASTM E 662	Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
ASTM F 1066	Specification for Vinyl Composition Floor Tile.
	Federal Specifications (FS)
SS-W-40	Wall Base: Rubber and Vinyl Plastic.
SS-T-312	Tile, Floor: Asphalt, Rubber, Vinyl, Vinyl Composition.
RR-T-650	Treads, Metallic and Non-Metallic.
	National Fire Protection Association (NFPA)
Standard 253	Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Maintain minimum temperature of 70 deg F (21 deg C) in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).

B. Do not install tiles until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during tile installation.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility for Floor Tile

Obtain each type, color, and pattern of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

B. Fire Test Performance

Provide resilient flooring which complies with the following fire test performance criteria as certified by the manufacturer or an independent testing laboratory acceptable to the Engineer.

1. Critical Radiant Flux (CRF): Not less than 0.45 watts per sq. cm. per ASTM E 648, or NFPA 253.
2. Flame Spread: Not more than 75 per ASTM E 84.
3. Smoke Density: Less than 450 per ASTM E 662.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver tiles and installation accessories to the construction site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, contract identification, and shipping and handling instructions.

B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).

C. Store tiles on flat surfaces. Move tiles and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products by one of the following, or approved equal:

Armstrong World Industries, Inc.; Lancaster, PA
Azrock Industries, Inc.; San Antonio, TX
Kentile Floors, Inc.; South Plainfield, NJ

2.02 MATERIALS

A. Provide materials, colors and patterns shown on the Contract Drawings. If colors and patterns are not shown, then as selected by Engineer from manufacturer's standards.

B. Tile Flooring, as listed below, where shown on the Contract Drawings:

1. Vinyl Composition Tile (VCT)

   Conform to ASTM F 1066, Composition 1 (asbestos free); 12-inch x 12-inch x 1/8-inch gage, unless otherwise shown on the Contract Drawings.

2. Vinyl Tile (VT)

   Conform to FS SS-T-312, Type III; 12-inch x 12-inch x 1/8-inch gage, unless otherwise shown on the Contract Drawings.

C. Vinyl Wall Base

Conform to FS SS-W-40, Type II; 4 inches high x 1/8-inch gauge, unless otherwise shown on the Contract Drawings. Vinyl wall base shall be coved at tile areas, toeless at carpet areas, with matching end stops and preformed or molded corner units.

D. Stair Covering, as listed below, where shown on the Contract Drawings

1. Vinyl Stair Treads

   Conform to FS RR-T-650, Type B; nominal 1/4-inch tapered thickness, square nose, single piece for full width and depth of tread.

2. Vinyl Stair Risers

   1/8-inch thick, single piece for full width and height of riser.

3. Vinyl Stringer Sheet: 0.080-inch thick.

E. Resilient Edge Strips

1/8-inch thick or as required to match tile thickness, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring, or as selected by Engineer from standard colors available; not less than 1 inch wide.

F. Adhesives (Cements)

Water-resistant type recommended by flooring manufacturer to suit material and substrate conditions.

G. Concrete Slab Primer

Non-staining type as recommended by flooring manufacturer.

H. Trowelable Underlayments and Patching Compounds

Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications shown on the Contract Drawings.

I. Extra Stock

Unless otherwise shown on the Contract Drawings, deliver to the Engineer prior to issuance of the Certificate of Final Completion, the following materials from the same manufactured lot as materials furnished for the Work of this Section. Deliver in sealed protective packaging marked with Contract Number and identification of contents:

1. Flooring

   Not less than one box for each 50 boxes or fraction thereof used in the Work of this Section, for each type, color and pattern.

2. Base, Stair Tread, Stair Riser and Edge Strip

   Not less than 15 linear feet of each item.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, coatings preventing adhesive bond, and other defects impairing performance or appearance. Report significant defects, if any, and proposed method of repair to the Engineer in writing. If such defects are determined by the Engineer to be attributable to Work performed by the Contractor, they shall be repaired by the Contractor to the satisfaction of the Engineer and at no cost to the Authority.

B. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry as well as to ascertain presence of curing compounds.

C. Do not proceed with resilient flooring Work until subfloor surfaces are satisfactory.

3.02 PREPARATION

A. Use trowelable leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes and depressions in subfloors.

B. Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds, paint, oils, waxes and sealers incompatible with resilient flooring adhesives.

C. Broom or vacuum clean substrates to be covered by tiles immediately before tile installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

D. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.03 INSTALLATION

A. General

Comply with tile manufacturer's installation directions and other requirements of this Section that are applicable to each type of tile installation included in this Contract.

B. Where movable partitions are shown on the Contract Drawings, install resilient flooring before partitions are erected.

C. Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring manufacturer's recommended bond and moisture test.

D. Install resilient flooring in strict compliance with manufacturer's printed instructions. Extend resilient flooring into toe spaces, door reveals, and into closets and similar openings.

E. Scribe, cut and fit resilient flooring to permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions.

F. Maintain reference markers, holes, or openings that are in place or plainly marked on subfloor for future cutting by repeating markings on finished flooring. Use chalk or other nonpermanent, marking device.

G. Install resilient flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

H. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

I. Lay tile from center marks established with principal walls, discounting minor offsets, so that tiles at opposite edges of room area are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown on the Contract Drawings.

J. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged, if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped or deformed tiles shall not be used. Lay tile with grain running in one direction, unless otherwise shown on the Contract Drawings.

K. Adhere tile flooring to substrate using full spread of adhesive applied in compliance with flooring manufacturer's directions.

L. Hand roll tiles where required by tile manufacturer.

M. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.

1. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

N. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately upon completion of resilient flooring:

1. Remove excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturer.
2. Vacuum floor thoroughly.
3. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.
4. Damp-mop floor, being careful to remove black marks and excessive soil.
5. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's directions.
6. Apply protective floor polish to resilient flooring surfaces free from soil, excess adhesive or surface blemishes. Use commercially available, metal cross-linked, acrylic product acceptable to resilient flooring manufacturer.
7. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors.
8. Cover resilient flooring with undyed, untreated building paper until final cleaning.

B. Clean resilient flooring prior to issuance of the Certificate of Final Completion by method recommended by resilient flooring manufacturer.

1. Strip protective floor polish, which was applied after completion of installation, prior to cleaning.
2. Reapply floor polish after cleaning.

END OF SECTION

SECTION 09660

RESILIENT TILE FLOORING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

09660A01 Complete layouts and design of the installation(s). Include a schedule of all materials to be furnished and installed as Work of this Section.

Samples

09660C01 Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors and patterns available for each type of resilient floor tile, wall base, and accessory shown on the Contract Drawings.

09660C02 Four full-size samples of floor tile for each selected color and pattern for verification. Tile samples shall show the quality, full color range and texture. Two one-foot lengths of each base and stair material for each selected color for verification.

Product Data

09660D01 One copy of U.S. Department of Labor Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during Work of this Section.

09660D02 Manufacturer's technical data for each type of resilient flooring, wall base, and accessory, including installation and maintenance instructions.

Certificates

09660E01 Certifications required by 1.04 B.

09660E02 Certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOC's).

Spare Parts List

09660N01 Extra stock in accordance with 2.02 I.

END OF APPENDIX "A"

09660

DIVISION 9

SECTION 09910

PAINTING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for shop and construction site application of paint as shown on the Contract Drawings.

B. Work of this Section includes surface preparation and painting of the following items and surfaces:

1. Exterior and interior painting in accordance with Appendix "B" to this Section.
2. Exposed bare and covered pipes, ducts and conduits, including color coding (if any), and hangers and supports.
3. Steel, iron work and miscellaneous metal items, and surfaces of architectural, mechanical and electrical items, if any.
4. Architectural woodwork and casework, if any.
   a. Surface preparation and shop staining or painting of architectural woodwork and casework is specified in other Sections of the Specifications.

C. These and similar items shall not be painted:

1. Items with factory-applied top coat.
2. Finished metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished metals.
3. Concealed pipes, ducts and conduits.
4. Concealed or inaccessible surfaces.
5. Code required labels such as Underwriters Laboratories and Factory Mutual.
6. Identification, performance rating, name or nomenclature plates of mechanical, electrical and fire equipment.
7. Operating and moving parts of operating units and mechanical and electrical equipment such as: valves, damper operators, linkages, sinkages, sensing devices, motors, shafts and sheaves.
8. Surfaces shown or scheduled on the Contract Drawings to receive spray-applied fire resistive material.
9. Galvanized steel surfaces unless noted otherwise on the Contract Drawings.

D. Definitions: "QC" refers to quality control or a quality control program. This is a methodology employed by the Contractor to ensure compliance with Contract requirements.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM D521	Standard Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder).
ASTM D523	Test Method for Specular Gloss.
ASTM D562	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer.
ASTM D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products.
ASTM D2369	Standard Test Method for Volatile Content of Coatings.
ASTM D2371	Standard Test Method for Pigment Content of Solvent-Reducible Paints.
ASTM D2697	Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings..
ASTM D3359	Standard Test Method for Measuring Adhesion by Tape Test.
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air.
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
ASTM D6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor using Anhydrous Calcium Chloride.

Northeast Protective Coating Committee (NEPCOAT)

NEPCOAT QPL	Qualified Products List

The Society for Protective Coatings (SSPC)

SSPC-PA 1	Shop, Field and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages.
SSPC-SP 1	Solvent Cleaning.
SSPC-SP 2	Hand Tool Cleaning.
SSPC-SP 3	Power Tool Cleaning.
SSPC-SP 5	White Metal Blast Cleaning.
SSPC-SP 6	Commercial Blast Cleaning.
SSPC-SP 7	Brush-Off Blast Cleaning.
SSPC-SP 10	Near-White Blast Cleaning.
SSPC-SP 11	Power Tool Cleaning to Bare Metal.
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel.

1.03 AMBIENT TEMPERATURE AND HUMIDITY REQUIREMENTS

A. Comply with the manufacturer's technical data sheets subject to approval by the Engineer as to environmental conditions under which paint and finishes may be applied, and with the following:

1. Do not apply paints in rain, snow, fog or mist, or when relative humidity exceeds 85 percent. Painting may be performed during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by the manufacturer(s) during application and drying periods.

2. Apply solvent based paint only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 degrees F..

3. Apply water-based paint only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F and 90 degrees F.

4. Apply paint to surfaces only when the surface temperature is at least 5 degrees F above the dew point.

5. Apply primer to non-metal surfaces only when the moisture content of surfaces meets the following criteria:

   a. Gypsum Wallboard: 0.5 percent maximum, when measured with an electronic moisture meter.

   b. Wood: 15 percent maximum, when measured with an electronic moisture meter.

   c. Concrete, Masonry and Plaster Walls: No visible moisture when measured in accordance with ASTM D4263.

6. Do not apply primer to concrete floors unless the moisture vapor emission rate is less than 3 pounds/1,000 square feet/24 hours when tested in accordance with ASTM F1869.

B. When painting and/or abrasive blasting operations are performed out of doors, no Work shall be performed when the U.S. Weather Bureau forecasts precipitation to commence prior to or within two hours after completion of such procedures and application of paint.

1.04 QUALITY ASSURANCE

A. Paint System Compatibility

The paint system, including all primers and undercoats, shall be produced by the manufacturer of the topcoat. Where this is not possible (as in cases of specialized primers used in the coating of miscellaneous components) review other Sections of the Specifications to determine the primer, surface preparation and treatment for the substrates and items to be field painted or finished as Work of this Section.

1. Notify the Engineer in writing of compatibility problems associated with the Work of this Section and substrates primed under other Sections of these Specifications.

B. Where shown on the Contract Drawings, provide not less than a 100 square foot full-coat finish sample(s) on actual surface(s) of coating material to be applied as Work of this Section, at a location selected by the Engineer. Such sample(s), when approved by the Engineer, may be incorporated into the Work and shall establish standards for color, texture and workmanship for the remainder of the Work of this Section.

C. Painting of Steel - Requirements

All painting of steel and galvanized steel must be done by firms that are approved by the Engineer. The firm shall have as a minimum the following:

1. Technical Capabilities

   a. Shops shall have areas available for specific operations, such as: receiving and lay down for steel to be coated; pre-cleaning of items to be coated; surface preparation; coating application; drying and curing of coated items; storage of coating materials.

   b. Blasters and painters must be trained. This training shall consist of at least 4 hours of instruction by a qualified instructor and shall cover various types of surface preparation equipment, paints and application equipment. Maintain instructor qualifications and training records and produce them when requested.

   c. There shall be procedures or processes in place to record specifications and revisions and to clarify ambiguous or incomplete specifications.

   d. There shall be a procedure for informing quality control and production personnel of job/shop procedures to meet requirements of this Specification.

2. Quality Control (QC)

   The entity performing painting of steel and galvanized steel shall have a written quality control program. The program shall contain, but not be limited to, the following:

   a. The qualifications of QC staff, including training records and experience.

   b. The authority of QC staff and reporting lines in the firm organization chart.

   c. Standards and specifications used by QC staff for inspection purposes.

   d. Inspection reports and other records documenting compliance with Authority requirements.

e. Inspection equipment and calibration standards used by QC staff and calibration procedures.

f. Procedure for QC staff to advise the shop foreman, in writing, of non-conforming Work.

3. Contractor's Responsibility

a. The Contractor is responsible for Quality Control, which entails the daily inspection of all painting by trained Quality Control staff. The Quality Control Program shall ensure that coating systems are applied according to the coating manufacturer's technical data sheets subject to approval by the Engineer for surface preparation, ambient conditions, application parameters, curing and film thickness.

b. The Engineer will perform Quality Assurance inspections to verify that the Contractor's Quality Control program is being followed.

4. Technical Advisor

Obtain the services of a technical advisor employed by the coating manufacturer to assist the Engineer and the Contractor during this Work. The technical advisor shall be a qualified representative, approved by the Engineer and shall be at the shop or work site prior to the opening of the coating containers. Consult with the technical advisor for instruction in the proper mixing of components and application of the materials. Arrange for the technical advisor to remain at the site until the Engineer is satisfied that the Contractor's personnel have mastered the proper handling, mixing and application of the materials.

5. Schedule and Engineer Approval

a. Submit a schedule for surface preparation and painting at least 30 days prior to beginning Work.

b. Notify the Authority Materials Engineering Division 10 days in advance of painting so arrangements can be made to inspect surface preparation prior to coating and application. In addition to inspecting surface preparation and coating the Authority will also perform tests to confirm blast profile and dry film thickness. Samples of coatings may be selected for testing by the Engineer.

c. *Do not paint steel until approval to proceed is given by the Engineer.*

6. Shop Painting of Steel

a. Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2 inches of embedded areas only.

(1) For high strength bolted surfaces with friction type connections, paint with an approved slip critical zinc rich coating.

b. Unless otherwise shown on the Contract Drawings, do not paint:

(1) Surfaces which are to be welded;

(2) Surfaces which are scheduled to receive sprayed-on fireproofing;

(3) Surfaces of exposed, corrosion-resistant, high-strength, low-alloy steel members.

c. Apply an additional coat of paint to surfaces which are inaccessible after assembly or erection. Change color of additional coat to distinguish it from first. Where shop painting is required, paint erection marks on painted surfaces.

d. Type of paint and surface preparations, if any, shall be as shown on the Contract Drawings, or as specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in the manufacturer's original unopened packages and containers bearing manufacturer's name, label and the following information:

1. Manufacturer's name.
2. Name or title of material.
3. Manufacturer's stock number and date of manufacture.
4. Shelf life.
5. Contract or order number under which the material has been ordered.
6. Lot and batch numbers.

B. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 degrees F and a maximum temperature of 90 degrees F in a well-ventilated area. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all necessary precautionary measures to ensure that workmen and Work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of materials.

C. Provide paint ready mixed to approved colors. Construction site tinting is prohibited.

D. Extra Material

Where requirements for extra materials are shown on the Contract Drawings, deliver to the Engineer prior to issuance of the Certificate of Final Completion not less than one gallon of each color of each coating applied as Work of this Section. Deliver extra material in the manufacturer's original, unopened containers, clearly labeled with product identification and Contract number.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 – GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria

1. All field-applied interior paints and coatings relating to work of this section shall meet the requirments of Division 1- GENERAL PROVISIONS.

2. All field-applied interior paints and coatings must not exceed the volatile organic compound (VOC) content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

3. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in Green Seal Standard CG-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

4. Clear wood finishes, floor coatings, stains, primers, and shellacs applied to the interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Provide paint systems and products of manufacturers in accordance with Appendix "B" to this Section, or approved equal.

B. When materials or products proposed to be used are products of manufacturers other than manufacturers specified in Appendix "B" to this Section, submit product information in accordance with the requirements of Division 1 - GENERAL PROVISIONS clause entitled "Substitution".

2.02 MATERIALS

A. Provide colors as shown on the Contract Drawings, or if not shown as required by the Engineer.

2.03 MIXES

A. Verify that the paint to be mixed has not exceeded its shelf life.

B. Mix and prepare painting materials in accordance with the manufacturer's technical data sheets subject to approval by the Engineer and 1.05 C.

C. Stir materials before application, and as required during application to produce a mixture of uniform density. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

D. Mix only complete kits of multi-component materials.

E. Colors

Each undercoat shall be a contrasting color to facilitate identification of each coat where multiple coats are to be applied as shown on the Contract Drawings.

2.04 ABRASIVES

A. Provide expendable or recyclable abrasives that are dry and free of oil, grease and corrosion-producing or other deleterious contaminants.

B. For the preparation of steel that is specified to be blasted, provide abrasives that are sized to produce a sharp, angular, uniform anchor pattern with a profile height of 2-3 mils, unless the requirements of the coating manufacturer are more restrictive. In this case, comply with profile requirements specified by coating manufacturer.

2.05 EQUIPMENT

A. Surface Preparation Equipment

1. Provide brushes, discs, wheels, scrapers, water jetting, blast cleaning and other surface preparation equipment sized properly to conduct the Work as specified in this Section and shown on the Contract Drawings.

2. Provide specialized equipment for the surface preparation of difficult-to-clean areas. Specialized equipment may include, but is not limited to:

   a. Angled nozzles or short nozzles for abrasive blast cleaning.

   b. Spin blast equipment.

B. Paint Application Equipment

1. Provide paint brushes, rollers and spray equipment to conduct the Work as specified in this Section.

2. Provide specialized equipment as required for the painting of difficult-to-paint areas. Specialized equipment may include, but is not limited to:

   a. Angled brushes for backs of nuts and bolts and other hard to reach areas.

   b. Mitts, daubers or other methods to supplement brush application.

PART 3. EXECUTION

3.01 PREPARATION

A. General

Perform preparation and cleaning procedures in accordance with the paint manufacturer's technical data sheets subject to approval by the Engineer and as specified in this Section, for each particular substrate condition.

1. *Ensure paint system compatibility in accordance with 1.04 A.*
2. Do not conduct final surface preparation which exposes the substrate to damp environmental conditions, or when the surface temperature is less than 5 degrees F above the dew point.
3. Remove hardware, hardware accessories, machined surfaces, lighting fixtures and similar items in place and not to be painted, or provide surface-applied protection prior to surface preparation and painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
4. When previously painted surfaces requiring field top coating are glossy (greater than 50 units at 60 degrees), first dull them using a 120 grit or greater (finer) grade sandpaper.
5. Thoroughly clean and remove all dust, oil, grease and other contaminants from surfaces to be painted. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

B. Surface Preparation

1. Steel

Remove slag, flux deposits, weld splatter and surface irregularities such as slivers, tears, fins and hackles; follow AWS Guidelines. Grind any resulting burrs smooth, including burrs around holes, if any. Do not remove any welding material that will weaken weld strength.

Prior to preparation, break sharp edges such as those created by flame cutting and shearing. Do not break rolled edges of angles, channels and wide flange beams without Engineer's approval.

Clean surfaces to remove oil, grease, soil and other soluble contaminants in accordance with SSPC-SP1 Solvent Cleaning. Where shown on the Contract Drawings, prepare surface in accordance with one or more of the following: SSPC-SP 2, SSPC-SP 3, SSPC-SP 5, SSPC-SP 6, SSPC-SP 7, SSPC-SP 10 and SSPC-SP 11. For welds, edges and holes, prepare surfaces to the same cleanliness level and profile as the surrounding steel.

a. Steel – Blast Cleaned

Unless otherwise shown on the Contract Drawings, perform abrasive blasting in accordance with SSPC-SP 10 Near White Blast Cleaning using a production line shot and grit blast machine or by air blast. Abrasives shall provide a sharp, angular profile. Maintain the abrasive work mix such that the final surface profile is within the required range. Use SSPC-VIS 1 to evaluate the degree of cleaning.

b. Provide expendable or recyclable abrasives that are dry and free of oil, grease, and corrosion producing, or other deleterious contaminants. Daily (or more frequently if required) check the abrasive for oil, grease or dirt contamination with the vial test. The test consists of adding a sample of abrasive from the inside of the blast machine to a sealable vial filled with deionized water. The vial is shaken for one minute and allowed to settle for five minutes. If any oil or grease is floating on top of the water, then the abrasive is contaminated. If the water becomes cloudy, then it contains dirt. Do not use contaminated or dirty abrasives to blast steel surfaces.

c. Compressed Air Cleanliness

(1) Provide compressed air that is free from moisture and oil contamination.

(2) Use the white blotter test in accordance with ASTM D4285 to verify the cleanliness of the compressed air. Conduct the test at least once per day for each compressor system. Sufficient freedom from oil and moisture is confirmed if soiling or discoloration are not visible on the paper.

(3) If air contamination is observed, change filters, clean traps, add moisture separators or filters or make adjustments as necessary to achieve clean, dry air. Reinspect surfaces prepared or coated since the last satisfactory test and repair, at no cost to the Authority, defective Work caused by contaminated air.

d. Surface Profile

The steel surface profile shall be 2-3 mils. Measure the surface profile of each girder, beam or diaphragm at three locations, paying special attention to areas that may have been shielded during blasting. Measure the surface profile using Testex Replica Tape in accordance with ASTM D4417. File the impressed tapes with the Quality Control inspection records.

2. Galvanized Steel Surfaces

a. Hot-dip galvanizing shall be by the "dry kettle" process. Do not quench galvanized items following galvanizing nor shall galvanized surfaces be treated with waxes, oils or chromates.

b. Chemical Treatment

Prepare the surface for painting in accordance with ASTM D6386 Zinc Phosphate Treatment. Follow the manufacturer's instructions for use of the materials. Prior to chemical treatment, remove white rust and other contaminants.

3. Aluminum Surfaces

Clean surfaces of oil, grease, dirt, and other foreign substances. Do not damage the aluminum. Use solvent cleaning in accordance with SSPC-SP 1.

4. Cementitious Materials

Prepare cementitious surfaces (concrete, concrete block and cement plaster) by removing efflorescence, chalk, dust, dirt, grease and oils. Remove oil and grease by detergent water cleaning and steam cleaning. Do not use solvents. For concrete surfaces, after removing oil and grease, prepare the surface for painting by abrasive blasting.

a. For concrete and other cementitious materials, perform appropriate tests as described in 1.03 A.5 to ensure that the moisture content is at or below the limit for painting and use only materials that are capable of being applied to alkaline surfaces. Do not paint over surfaces where moisture content exceeds that permitted in 1.03 A.5.

5. Wood

Wipe off dust and grit from miscellaneous wood items and millwork prior to priming, using a solution of tri-sodium phosphate and water. Rinse off surfaces with clean water. Spot coat knots, pitch streaks and sappy sections with sealer. Fill nail holes and cracks after primer has dried and sand with a fine grade sand paper between coats. Back prime interior and exterior woodwork.

a. Where clear finishes are shown on the Contract Drawings, ensure that fillers match wood tint. Work fillers into grain. Wipe excess from the surface.

3.02 APPLICATION

A. General

1. Apply paint in accordance with SSPC-PA 1 and the manufacturer's technical data sheets subject to approval by the Engineer. Use applicators and techniques best suited for substrate and type of material being applied. Follow the manufacturer's technical data sheets, subject to approval by the Engineer, for cure times, temperature and humidity conditions and recoat times as the individual coats of the specified system are applied.

a. For blast cleaned steel, apply the prime coat on the same day (within 12 hours) that the substrate was cleaned. If the base substrate is allowed to remain uncoated for more than 12 hours, or rerusting is observed, reblast the steel prior to painting.

2. Do not apply paint in areas where dust is being generated.

3. Apply each coat at proper consistency. After each coat has dried, visually examine for pinholes, fish eyes, blisters, runs, sags and missed areas. Repair defects and repaint.

4. Apply additional coats when undercoats, stains or other conditions show through top coat of paint, until paint film is of uniform finish, color and appearance. Apply stripe coats of the prime and finish coat to all edges, corners, crevices, welds and other surface irregularities.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.

6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

7. Paint backsides of access panels, and removable or hinged covers to match exposed surfaces.

8. Finish exterior doors on tops, bottoms and side edges the same as exterior faces.

9. Sand lightly between each succeeding enamel or varnish coat.

10. Omit first coat (primer) on metal surfaces which have been shop-primed.

11. Paint primed surfaces to color shown on the Contract Drawings.

12. Where shown on the Contract Drawings, prime and paint the following to match adjacent surface: exposed bare pipes, ducts, conduits, boxes, hangers, brackets and supports, except where items are covered with a prefinished coating.

13. Color code equipment, piping conduit and exposed ductwork as shown on the Contract Drawings.

B. Scheduling Painting

Apply paint to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Abide by the coating manufacturer's minimum and maximum recoat times subject to approval by the Engineer. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Coating Thickness

Apply materials at the manufacturer's recommended spreading rate, to establish a total dry film thickness as shown on the Contract Drawings or, if not shown, as recommended by coating manufacturer and as approved by the Engineer. Monitor paint application rate by use of wet film thickness gage in accordance with ASTM D4414. For metal surfaces, measure dry film thickness in accordance with SSPC-PA 2. Use a non-ferrous guage to measure coating thickness on galvanized surfaces or aluminum.

1. Give special attention to ensure that surfaces such as edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

2. Apply additional coating to areas of insufficient thickness. Use care during application to assure that all repairs blend in with the surrounding surfaces.

3. Unless directed otherwise by the Engineer, remove excessive coating thickness and reapply the affected coat(s).

D. Coating Adhesion

1. Apply all coats in such a manner to assure that they are well-adhered to each other and to the substrate. If the application of any coat causes lifting of an underlying coat, or if there is poor adhesion between coats or to the substrate, remove the coating in the affected area to adjacent sound, adherent coating and reapply the material.

2. If adhesion is suspect, conduct adhesion tests in accordance with ASTM D3359 or ASTM D4541 as directed by the Engineer and repair all test areas. The acceptance criteria for the testing will be established by the Engineer. Replace all defective coating that is revealed by the testing.

E. Completed Work

Match approved samples for color, texture and coverage. Remove, refinish or repair Work not in compliance with the requirements specified in this Section.

F. Field Painting – Fasteners

1. After erection or installation, all rust, scale, dirt, grease and other foreign material on bolts, nuts and washers shall be completely removed by solvent cleaning in accordance with SSPC-SP 1 followed by hand tool cleaning SSPC-SP 2, or power tool cleaning SSPC-SP 3.

2. Apply brush applications of primer and intermediate to bolts, nuts and washers after tensioning. Apply topcoat by spray application. Give careful attention to bolted connections to ensure that all bolts, nuts and washers are fully coated.

G. Repair of Damaged and Unacceptable Coatings

1. Surface Preparation of Localized Areas

a. Repair localized damage, corrosion and unacceptable coatings.

b. Prepare the surface by cleaning in accordance with SSPC-SP 1 Solvent Cleaning followed by SSPC-SP 2 Hand Tool Cleaning or SSPC-SP 3 Power Tool Cleaning. Use a solvent that is acceptable to the paint manufacturer.

c. For previously blast-cleaned steel, if the damage exposes the substrate, remove all loose material and prepare the steel in accordance with SSPC-SP 11.

d. For galvanized steel, repair damaged galvanizing in accordance with ASTM A780. Use a zinc-rich coating containing a minimum of 92 percent zinc in the dry film.

2. Surface Preparation of Extensive Areas

a. Repair extensive areas of damage or unacceptable coating by methods acceptable to the Engineer, based on the nature of the defect.

b. For previously blast-cleaned steel, blast surfaces back to original requirements. Use extreme care to avoid overblast damage to the surrounding coating.

3. Feathering of Repair Areas

a. Feather the existing coatings surrounding each repair location. Feather for a distance of 1 to 2 inches to provide a smooth, tapered transition into the coating.

b. Verify that the edges of coating around the periphery of the repair areas are tight and intact by probing with a putty knife in accordance with the requirements of SSPC-SP 3 Power Tool Cleaning. Roughen the existing coating in the feathered area to assure proper adhesion of the repair coats.

H. Coating Application in Repair Areas

1. When the bare substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

2. When the damage does not extend to the bare substrate, apply only the affected coats.

3. Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.

I. Clean-up

During progress of Work, remove discarded paint materials, rubbish, cans and rags daily. Upon completion of painting Work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.03 PAINT TESTING

A. The Authority reserves the right to conduct tests of the materials at any time, and any number of times during shop or field painting.

1. The Engineer may sample the paint(s) being used. A representative pint or quart sample of each component of paint(s) at the construction site will be transferred to metal containers, identified, sealed and certified in the presence of the Contractor.

2. Tests on paint samples may be conducted by the Engineer to confirm manufacturer's submittals made under Appendix "A". Any or all of the following tests may be conducted:

a. Viscosity (Stormer @ 25 degrees C) KU, ASTM D562.

b. Percent Total Solids by Weight, ASTM D2369.

c. Volatile Organic Compounds (VOC), ASTM D2369.

d. Weight per Gallon, ASTM D1475.

e. Volume Nonvolatile Matter, ASTM D2697.

f. Pigment Content, ASTM D2371.

g. Percent Metallic Zinc in Primer, ASTM D521.

h. Specular Gloss of Finish Coat, ASTM D523.

i. Infrared Identification - of individual components and of the mixed coatings for 2 component materials. Obtain each spectrum by sandwiching a small quantity (i.e., 1-2 drops) of material between 2 potassium bromide plates and obtaining a transmission infrared spectrum. For the mixed and cured material, use a solid sampling technique.

3. If the Engineer determines upon review of laboratory tests that the material being used does not comply with the requirements specified in this Section, he may direct the Contractor to stop painting Work and remove non-complying paint, to repaint surfaces coated with rejected paint or to remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

3.04 PROTECTION

Protect other adjacent Work against damage by painting and finishing Work. Correct damage by cleaning, repairing or replacing, and repainting, as approved by the Engineer.

A. Provide "Wet Paint" signs to protect newly painted finishes. After completion of painting operations, remove temporary protective wrappings for protection of adjacent and existing conditions.

B. At completion of Work of other trades, touch-up and restore damaged or defaced painted surfaces.

C. Ensure that coated items are not shipped until cured. Protect all fully coated and cured items from handling and shipping damages using padded slings, dunnage, separators and tie-downs.

END OF SECTION

SECTION 09910

PAINTING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's technical data sheets including the following information for each coating:

- Volume Solids
- VOC
- DFT range
- DFT maximum
- Zinc content (zinc primers only)
- Slip coefficient (zinc primers only)
- Substrates
- Surface preparation
- Profile
- Storage temperature
- Primers
- Topcoats
- Application equipment, including touchup
- Mixing
- Thinners
- Thinning maximum
- Sweat-in-time
- Pot life
- Application schedule -
- Minimum surface/air temperatures and humidity
- Maximum surface/air temperatures and humidity
- Drying schedule -
- Dry to handle
- Dry to topcoat
- Maximum recoat
- Cure.

B. Samples

1. Submit in color(s) shown on the Contract Drawings, or if not shown, in color(s) as selected by the Engineer from manufacturer's color chart.

2. On a 12 inch by 12 inch hardboard or metal panels, two samples of each paint and coating material, if required by the Engineer. If more than one application method is to be used, submit two samples of each paint and coating material for each application method.

3. Identify each sample as to manufacturer, color name and number, location and application.

   a. On actual wood surfaces, two 4 inch by 8 inch samples of each natural and stained wood material. Identify each sample as to manufacturer and location application.

C. Submit to the Engineer one copy of U.S. Department of Labor, Material Safety Data Sheets (MSDS) for hazardous chemicals utilized during the Work of this Section.

D. Submit the paint applicator's qualifications and/or experience.

E. Submit a copy of the quality control program, as required by 1.04 C.2, if requested by the Engineer.

F. Submit instructor qualifications and training records for blasters and painters as required by 1.04 C.1.b, if requested by the Engineer.

G. Submit copy of daily inspection reports if requested by the Engineer.

H. Sustainable Design Submittal Requirements;

The contractor shall submit the Sustainable Design certification items listed herein.

Sustainable Design submittals shall include the following.

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 – GENERAL PROVISIONS. Information to be supplied for this form shall include:
   a. Cost breakdowns for the materials included in the Contractor's Work. Cost *breakdowns shall include total cost plus itemized material costs.*
   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:
      1) The VOC content of all adhesives, sealants, paints and coatings applied on site as part of this work.
2. Published Product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.
3. Product cut sheets for materials that meet the SDMCF.
4. Material Safety Data Sheets (MSDS) for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compounds (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufactures literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).
5. The sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

SECTION 09910

PAINTING

APPENDIX "B"

PAINT SCHEDULE

A. Exterior

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Gloss	C-1G	Water Based Primer Sealer	Carboline Carbocrylic 120	Acrylic Gloss	Carboline Carbocrylic 3359 DTM	Acrylic Gloss	Carboline Carbocrylic 3359 DTM
			PPG Perma-Crete 4-603		PPG Pitt-Tech Plus 90-1310		PPG Pitt-Tech Plus 90-1310
			SW Loxon Acrylic Primer A24W8300		SW DTM Acrylic B66-100 Series		SW DTM Acrylic B66-100 Series
Concrete Semi-Gloss	C-1S	Water Based Primer Sealer	Carboline Carbocrylic 120	Acrylic	Carboline Sanitile 155	Acrylic Semi-Gloss	Carboline Sanitile 155
			PPG Perma-Crete 4-603		PPG Pitt-Tech Plus 90-1210		PPG Pitt-Tech Plus 90-1210
			SW Loxon Acrylic Primer A24W8300		SW DTM Acrylic B66-200 Series		SW DTM Acrylic B66-200 Series

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Masonry Gloss	CM-1G	Water Based Block Filler	Carboline Sanitile 100	Acrylic Gloss	Carboline Carbocrylic 3359 DTM	Acrylic Gloss	Carboline Carbocrylic 3359 DTM
			SW Heavy Duty Block Filler B42W46		SW DTM Acrylic B66-100 Series		SW DTM Acrylic B66-100 Series
			PPG Speedhide 6-15		PPG Pitt-Tech Plus 90-1310		PPG Pitt-Tech Plus 90-1310
Concrete Masonry Semi-Gloss	CM-1S	Water Based Block Filler	Carboline Sanitile 100	Acrylic Semi-Gloss	Carboline Sanitile 155	Acrylic Semi-Gloss	Carboline Sanitile 155
			PPG Speedhide 6-15		PPG Pitt-Tech Plus 90-1210		PPG Pitt-Tech Plus 90-1210
			SW Heavy Duty Block Filler B42W46		SW DTM Acrylic B66-200 Series		SW DTM Acrylic B66-200 Series
Cement Plaster Walls & Soffits Gloss	P-1G	Water Based Primer Sealer	Carboline Carbocrylic 120	Alkyd Gloss	Carboline Carbocoat 30R	Alkyd Gloss	Carboline Carbocoat 30R
			PPG Perma-Crete 4-603		PPG 95-5000 Series		PPG 95-5000 Series
			SW Loxon Acrylic Primer A24W8300		SW Industrial Enamel HS B54Z-400 Series		SW Industrial Enamel HS B54Z-400 Series
Steel Gloss	S-1G*	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 888	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG
			PPG PMC Amercoat 68 HS		PPG PMC Amercoat 399		PPG PMC Amercoat 450 H
			SW Zinc Clad III HS		SW Macropoxy 646		SW Acrolon 218 B65-600

*Paint system S-1G must be on the current New England Protective Coatings (NEPCOAT) Qualified Product List.

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel Gloss	S-2G	Inorganic Zinc Rich	Carboline Carbozinc 11 HS	Epoxy	Carboline Carboguard 893	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG
			PPG PMC Dimetcote 9 HS		PPG PMC Amercoat 385		PPG PMC Amercoat 450 H
			Sherwin-Williams Zinc Clad II		Sherwin Williams Macropoxy 646		Sherwin-Williams Acrolon 218HS B65-600
Steel Semi-Gloss	S-1S*	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 888	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			PPG PMC Amercoat 68 HS		PPG PMC Amercoat 399		PPG PMC Amercoat 450 HSG
			SW Zinc Clad III HS		SW Macropoxy 646		SW Acrolon 218 HS
	*Paint system S-1S must be on the current New England Protective Coatings (NEPCOAT) Qualified Product List.						
Steel Semi-Gloss	S-2S	Inorganic Zinc Rich	Carboline Carbozinc 11 HS	Epoxy	Carboline Carboguard 893	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			PPG PMC Dimetcote D9 HS		PPG PMC Amercoat 385		Amercoat 450 HSG
			Sherwin-Williams Zinc Clad II		Sherwin-Williams Macropoxy 646		Sherwin-Williams Acrolon 218 HS

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel Semi-Gloss	S-3S	Aluminum Epoxy Mastic	Carboline Carbomastic 15	Epoxy	Carboline Carboguard 890	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			PPG PMC Amerlock 2 AL		PPG PMC Amercoat 385		PPG PMC Amercoat 450 HSG
			SW Epoxy Mastic Aluminum II		SW Macropoxy 646		SW Acrolon 218 HS
Galvanized & Aluminum Gloss	N-1G	Primer	PPG Pitt-Tech Plus 90-912		N/A	Acrylic Gloss	PPG Pitt-Tech Plus 90-1310
			SW Pro-Cryl B66 - 310 Series				SW DTM Acrylic B66-100 Series
			Carboline Galoseal WB				Carboline 3359 DTM
Galvanized & Aluminum Semi-Gloss	N-1S	Primer	PPG Pitt-Tech Plus 90-912		N/A	Acrylic Semi-Gloss	PPG Pitt-Tech Plus 90-1210
			SW Pro-Cryl B66 - 310 Series				SW DTM Acrylic B66-200 Series
			Carboline Galoseal WB				Carboline 3359
Galvanized & Aluminum (Marine & Bridge)	N-2S	Epoxy Primer	Carboline Carboguard 888		N/A	Aliphatic Polyurethane	Carboline Carbothane 133 LH
			SW Macropoxy 646				SW Acrolon 218 HS
			PPG PMC Amercoat 385				PPG PMC Amercoat 450 HSG

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Galvanized & Aluminum (Marine & Bridge) Gloss	N-2G	Epoxy Primer	Carboline Carboguard 888 PPG PMC Amercoat 385 SW Macropoxy 646		N/A	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG PPG PMC Amercoat 450 H SW Acrolon 218 HS B65-600
Plywood Semi-Gloss	PW-1S	Acrylic Wood Primer	Carboline Carbocrylic 120 SW A-100 Latex B42W42 PPG Speedhide 6-609	Acrylic Semi-Gloss	Carboline Carbocrylic 3359 SW Metalatex B42 Series PPG Speedhide 6-900	Acrylic Semi-Gloss	Carboline Carbocrylic 3359 SW Metalatex B42 Series PPG Speedhide 6-900
Concrete, Brick & Granite Clear Gloss Anti-Graffiti	AG-1	Primer Sealer	Carboline Carboguard 1340 Visual Pollution Tech. Crystal Clear		N/A	Aliphatic Urethane	Carboline Carbothane 130 Visual Pollution Tech. Crystal Clear
Concrete, Brick & Granite Clear Flat Anti-Graffiti	AG-2	Primer Sealer	Degussa Tagguard Sivento Protectosil Tristar Proteus Masonry Sealer		N/A	Various	Degussa Tagguard Sivento Protectosil Tristar Proteus 940

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel & Concrete Saltwater Immersion	CT-1	Coal Tar Epoxy (C-200A)	Carboline Bitumastic 300M International Intertuf 702 Sherwin-Williams Targuard		N/A	Coal Tar Epoxy (C-200A)	Carboline Bitumastic 300M International Intertuf 702 Sherwin-Williams Targuard
Steel, Jet Fuel Splash & Spill	S-4	Organic Zinc Rich	Carboline Carbozinc 859 Tnemec 90-97 Tneme-Zinc SW Zinc Clad III HS	Epoxy	Carboline Carboguard 890 Tnemec Epoxoline II Series N69 SW Macropoxy 646	Polyester Polyurethane	Carboline Carbothane 133 LH Tnemec CRU Series 290 SW Poly-Lon HP
Steel Slip Critical "B"	S-5	Organic Zinc Rich	Carboline Carbozinc 859 PPG PMC Amercoat 68 HS SW Zinc Clad III HS		N/A		N/A
Steel Slip Critical "B"	S-6	Inorganic Zinc Rich (Shop Only)	PPG PMC Dimetcote 9 Carboline Carbozinc 11 HS Sherwin-Williams Zinc Clad II		N/A		N/A

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel (under concrete or grout)	S-7	Epoxy Mastic	Carboline Carboguard 890 PPG PMC Amerlock 2 Sherwin-Williams Macropoxy 646		N/A	Epoxy (immersion grade)	Carboline Carboguard 890 PPG PMC Amerlock 2 Sherwin-Williams Macropoxy 646
Steel, Saltwater, Tidal	S-8	Epoxy	Duramar 2510 UW International Interzone 954 Sherwin-Williams Sher-Glass	N/A		Epoxy	Duramar 2510 UW International Interzone 954 Sherwin-Williams Sher-Glass
Steel, Ultra-Weatherable	S-9	Zinc Rich	Carboline Carbozinc 859 SW Zinc Clad III HS PPG PMC Amercoat 68 HS	Urethane	Carboline Carbothane 134 HG SW Acrolon 218 HS PPG BRP 1000 Series	Fluorocarbon	Carboline Carboxane 950 SW FluoroKem PPG Coraflon ADS
Steel, Rapid Deployment	S-10	Zinc Rich	PPG PMC 68 HS Sherwin-Williams Corothane I - Galvapac		N/A		PPG PMC PSX 700 Sherwin-Williams Fast Clad Urethane
Aluminum Ultra-Weatherable	N-3	Epoxy	Carboline Carboguard 888 Sherwin-Williams Macropoxy 646 PPG PMC Amercoat 385	Urethane	Carboline Carbothane 133 LH Sherwin-Williams Acrolon 218 HS PPG BRP 1000 Series	Fluorocarbon	Carboline Carboxane 950 Sherwin-Williams FluoroKem PPG Coraflon ADS

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
B. Interior							
Steel, water tank	S-11	Epoxy	PPG PMC Amerlock 2	Epoxy	PPG PMC Amerlock 2	Epoxy	PPG PMC Amerlock 2
			Carboline Carboguard 891		Carboline Carboguard 891		Carboline Carboguard 891
			SW Duraplate 235 NSF		SW Duraplate 235 NSF		SW Duraplate 235 NSF
Steel, jet fuel tank	S-12	Epoxy Amine	PPG PMC Amercoat 395 FD		N/A	Epoxy Amine	PPG PMC Amercoat 395 FD
			Carboline Plasite 9060				Carboline Plasite 9060
			SW Shelcote II				SW Shelcote II
Concrete Flat	C-2F	Water Based Sealer	PPG Speedhide 6-2	Acrylic	PPG Speedhide 6-70	Acrylic Flat	PPG Speedhide 6-70
			ProMar B28W8200		SW ProMar B30W200		SW ProMar B30W200
			Carboline 120		Carboline 3130		Carboline 3130
Concrete Semi-Gloss	C-2S	Water Based Sealer	Carboline Carbocrylic 120	Acrylic	Carboline Carbocrylic 3359	Acrylic Semi-Gloss	Carboline Carbocrylic 3359
			SW ProMar B28W8200		SW ProMar B31W200		SW ProMar B31W200
			PPG Speedhide 6-2		PPG Speedhide 6-500		PPG Speedhide 6-500

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Heavy-Duty Gloss	C-3G	Epoxy	Carboline Carboguard 1340 SW Macropoxy HS Epoxy	Epoxy	Carboline Carboguard 890 SW HP Epoxy B67-200	Epoxy Gloss	Carboline Carboguard 890 SW HP Epoxy B67-200
Concrete Masonry Flat	CM-2F	Block Filler	PPG Speedhide 6-7 SW PrepRite B25W25 Carboline Sanitile 100	Acrylic	PPG Speedhide 6-70 SW ProMar B30W200 Carboline 3130	Acrylic Flat	PPG Speedhide 6-70 SW ProMar B30W200 Carboline 3130
Concrete Masonry Semi-Gloss	CM-2S	Block Filler	Carboline Sanitile 100 SW PrepRite B25W25 PPG Speedhide 6-7	Acrylic	Carboline Carbocrylic 3359 SW ProMar B31W200 PPG Speedhide 6-500	Acrylic Semi-Gloss	Carboline Carbocrylic 3359 SW ProMar B31W200 PPG Speedhide 6-500
Concrete Masonry Heavy-Duty Gloss	CM-3	Epoxy Block Filler	Carboline Carboguard 954HB SW Kem Cati-Coat HS B42W400	Epoxy	Carboline Carboguard 890 SW HP Epoxy B67-200	Epoxy Gloss	Carboline Carboguard 890 SW HP Epoxy B67-200
Cement & Gypsum Plaster Walls & Soffits Flat	P-1F	Acrylic Sealer	SW PrepRite B28W300 PPG Speedhide 6-2 Carboline Sanitile 120	Acrylic	SW ProMar B30W200 PPG Speedhide 6-70 Carboline 3130	Acrylic Flat	SW ProMar B30W200 PPG Speedhide 6-70 Carboline 3130

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Cement & Gypsum Plaster Walls & Soffits Semi-Gloss	P-1S	Acrylic Sealer	Carboline Carbocrylic 120	Acrylic	Carboline Carbocrylic 3359	Acrylic Semi-Gloss	Carboline Carbocrylic 3359
			SW PrepRite B28W300		SW ProMar B31W200		SW ProMar B31W200
			PPG Speedhide 6-2		PPG Speedhide 6-500		PPG Speedhide 6-500
Gypsum Board Flat	GB-1F	Acrylic Sealer	SW PrepRite B28W8200	Acrylic	SW ProMar B30W200	Acrylic Flat	SW ProMar B30W200
			PPG Speedhide 6-2		PPG Speedhide 6-70		PPG Speedhide 6-70
			Carboline Sanitile 120		Carboline 3130		Carboline 3130
Gypsum Board Semi-Gloss	GB-1S	Acrylic Sealer	Carboline Carbocrylic 120	Acrylic	Carboline Carbocrylic 3359	Acrylic Semi-Gloss	Carboline Carbocrylic 3359
			SW PrepRite B28W8200		SW ProMar B31W200		SW ProMar B31W200
			PPG Speedhide 6-2		PPG Speedhide 6-500		PPG Speedhide 6-500
Steel Semi-Gloss	S-13S	Acrylic Steel Primer	PPG Pitt-Tech Plus 90-912	Acrylic	PPG Pitt-Tech Plus 90-1210	Acrylic Semi-Gloss	PPG Pitt-Tech Plus 90-1210
			SW DTM B66 W1		SW Sher-Cryl B66-350		SW Sher-Cryl B66-350
			Carboline 3358		Carboline 3359		Carboline 3359
Steel Gloss	S-14G	Acrylic Steel Primer	Carboline Carbocrylic 3358	Acrylic	Carboline Carbocrylic 3359 DTM	Acrylic Semi-Gloss	Carboline Carbocrylic 3359 DTM
			SW DTM B66W1		SW DTM Sher-Cryl B66-300		SW DTM Sher-Cryl B66-300
			PPG Pitt-Tech Plus 90-912		PPG Pitt-Tech Plus 90-1310		PPG Pitt-Tech Plus 90-1310

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel Heavy-Duty Semi-Gloss (UV Exposure)	S-14S	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 888	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			PPG PMC Amercoat 68 HS		PPG PMC Amercoat 399		PPG PMC Amercoat 450 HSG
			SW Zinc Clad III HS		SW Macropoxy 646		SW Acrolon 218 HS
Steel Heavy-Duty	S-15	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 890	Epoxy	Carboline Carboguard 890
			SW Zinc Clad III HS		SW Macropoxy 646		SW Macropoxy 646
			PPG PMC Amercoat 68 HS		PPG PMC Amerlock 2		PPG PMC Amerlock 2
Galvanized & Aluminum Gloss	N-4G	Primer	Carboline Carbocrylic 120		N/A	Acrylic Gloss	Carboline Carbocrylic 3359 DTM
			PPG Pitt-Tech Plus 90-912				PPG Pitt-Tech Plus 90-1310
			SW Pro-Cryl B66-310 Series				SW Sher-Cryl B66-300
Galvanized & Aluminum Semi-Gloss	N-4S	Primer	PPG Pitt-Tech Plus 90-912		N/A	Acrylic Semi-Gloss	PPG Pitt-Tech Plus 90-1210
			SW Pro-Cryl B66-310 Series				SW Sher-Cryl B66-350
			Carboline Carbocrylic 120				Carboline 3359

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Galvanized & Aluminum Heavy Duty Semi-Gloss	N-5S	Epoxy	Carboline Carboguard 888		N/A	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			SW Macropoxy 646				SW Acrolon 218 HS B65-650
			PPG PMC Amercoat 385				PPG Amercoat 450 HSG
Plywood Flat	PW-2F	Acrylic	Carboline Carbocrylic 120	Acrylic	Carboline 3130	Acrylic	Carboline 3130
			SW PrepRite ProBlock B51W20		SW ProMar B30W200		SW ProMar B30W200
			PPG SealGrip 17-921		PPG Speedhide 6-70		PPG Speedhide 6-70
Plywood Semi-Gloss	PW-2S	Acrylic	Carboline Carbocrylic 120	Acrylic	Carboline Carbocrylic 3359	Acrylic	Carboline Carbocrylic 3359
			SW Preprite ProBlock B51W20		SW ProMar B31W200		SW ProMar B31W200
			PPG SealGrip 17-921		PPG Speedhide 6-500		PPG Speedhide 6-500

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Floor Clear Finish	CF-2	Epoxy	PPG MegaSeal HSPC 99-12700 SW ArmorSeal 33 Carboline Carboguard 1340		N/A	Epoxy	PPG MegaSeal SL 99-12600 SW 650 SL/RC Carboline Sanitile 925
Concrete Floor Color Finish Heavy-Duty Gloss	CF-3	Epoxy	Carboline Semstone 110 SW ArmorSeal 33 PPG MegaSeal HSPC 99-12710	Epoxy	Carboline Sanitile 945 SL SW ArmorSeal 650 SL/RC PPG MegaSeal SL	Epoxy	Carboline Sanitile 945 SL SW ArmorSeal 650 SL/RC PPG MegaSeal SL
Concrete Color Finish Anti-Graffiti	AG-3	Epoxy	Carboline Rustbond Penetrating Sealer SW Macropoxy 920		N/A	Polyester Urethane	Carboline Carbothane 133 LH SW Polylon HP
Concrete Masonry, Color Finish Anti-Graffiti	AG-4	Concrete Block Filler	Carboline Carboguard 954 HB SW Kem Cati-Coat HS		N/A	Polyester Urethane	Carboline Carbothane 133 LH Sherwin-Williams Polylon HP

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
C. Overcoat Systems							
Steel	S-16	Alkyd Spot Primer	Carboline Carbocoat 8215C		N/A	Silicone Alkyd	Carboline 30 R
			SW Kromik Metal Primer				SW Steel Master 9500 B56-300 Series
			PPG Multiprime 97-680				PPG Sil-Shield 95-5000
Steel	S-17	MC Urethane Spot Primer	Wasser MC-Prepbond	MC Urethane	Wasser MC-Prepbond	MC Urethane	Wasser MC-Luster
			Xymax MonoLock PP		Xymax MonoLock PP		Xymax Bridge Finish
			SW Corothane I Mio-Aluminum		SW Corothane I Ironox B		SW Corothane I HS
Galvanized & Aluminum Semi-Gloss	N-6S	Epoxy Spot Primer	Carboline 888 Epoxy	Tie Coat	Carboline Rustbond	Urethane	Carboline 133LH
			SW Macropoxy 646		SW Macropoxy 920 Pre-Prime		SW Acrolon 218 HS
			PPG PMC Amercoat 385		PPG PMC Amerlock Sealer		PPG PMC 450 HSG
Steel Semi-Gloss	S-18	Epoxy Mastic Spot Primer	PPG PMC Amerlock 2AL	Tie Coat	PPG PMC Amerlock Sealer	Polyurethane	PPG PMC Amercoat 450 HSG
			Carboline Carbomastic 615 HS		Carboline Rustbond		Carboline 133 LH
			SW Epoxy Mastic Aluminum II		SW Macropoxy 920 Pre-Prime		SW Acrolon 218 HS

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Semi-Gloss	C-4S	Spot Primer	Carboline Sanitile 120	Acrylic	Carboline Sanitile 155	Acrylic	Carboline Sanitile 155
			PPG Perma-Crete 4-603		PPG Pitt-Tech Plus 90-1210		PPG Pitt-Tech Plus 90-1210
			SW Loxon A24W8300		SW DTM Acrylic B66-200		SW DTM Acrylic B66-200
Concrete Masonry Semi-Gloss	CM-4S	Block Filler Spot Primer	Carboline Sanitile 100	Acrylic	Carboline Sanitile 155	Acrylic	Carboline Sanitile 155
			SW H.D. Block Filler B42W46		SW DTM Acrylic B66-200		SW DTM Acrylic B66-200
			PPG Pitt-Glaze 16-90		PPG Pitt-Tech Plus 90-1210		PPG Pitt-Tech Plus 90-1210

D. Interior - Sustainable Design

Concrete Masonry Flat	CM-5F	Block Filler	PPG 6-7 Speedhide Latex Block Filler	Acrylic Flat	PPG 9-100 Pure Performance Flat Interior Latex	Acrylic Flat	PPG 9-100 Pure Performance Flat Interior Latex
			SW PrepRite B25W25		SW ProGreen B30-600		SW ProGreen B30-600
			Carboline Sanitile 100		Carboline 3130		Carboline 3130

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Masonry Semi-Gloss	CM-5S	Block Filler	PPG 6-7 Speedhide Latex Block Filler	Acrylic	PPG 9-500 Pure Performance Interior Latex Primer	Acrylic Semi-Gloss	PPG 9-500 Performance Interior Latex Finish Semi-Gloss
			SW PrepRite B25W25		SW ProGreen B31-600		SW ProGreen B31-600
			Carboline Sanitile 100		Carboline 3234		Carboline 3234
Cement & Gypsum Plaster Walls & Soffits Semi-Gloss	P-2S	Acrylic Sealer	PPG 9-900 Pure Performance Interior Latex Primer	Acrylic	PPG 9-500 Pure Performance Interior Latex	Acrylic Semi-Gloss	PPG 9-500 Pure Performance Interior Latex
			SW Loxon A24W8300		SW ProGreen B31-600		ProGreen B31-600
			Carboline Sanitile 120		Carboline 3234		Carboline 3234
Gypsum Board Flat	GB-2F	Acrylic Sealer	PPG 9-900 Pure Performance Latex Primer	Acrylic	PPG 9-100 Pure Performance Latex	Acrylic Flat	PPG 9-100 Pure Performance Latex
			SW ProGreen 200 B28W600		SW ProGreen 200 B30-600		SW ProGreen 200 B30-600
			Carboline Sanitile 120		Carboline 3130		Carboline 3130
Gypsum Board Semi-Gloss	GB-2S	Acrylic Sealer	PPG 9-900 Pure Performance Latex	Acrylic	PPG 9-500 Pure Performance Latex	Acrylic Semi-Gloss	PPG 9-500 Pure Performance Latex
			SW ProGreen 200 B28W600		SW ProGreen 200 B31-600		SW ProGreen 200 B31-600
			Carboline Sanitile 120		Carboline 3234		Carboline 3234

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Steel Semi-Gloss	S-19S	Acrylic Steel Primer	PPG 90-912 Series Pitt-Tech DTM Industrial Enamel	Acrylic	PPG Pitt-Tech Plus 90-1210	Acrylic Semi-Gloss	PPG Pitt-Tech Plus 90-1210
			Carboline Carbocrylic 3358 MC		Carboline 3234		Carboline 3234
			SW Pro-Cryl Universal Primer		SW Pro Industrial B66-650		SW Pro Industrial B66-650
Steel-Heavy Duty Gloss	S-20G	Organic Zinc-Rich	PPG PMC Amercoat 68 HS VOC	Epoxy	PPG PMC Amercoat 399	Urethane	PPG PMC Amershield VOC
			Carboline Carbozinc 859 VOC		Carboline Carboguard 894		Carboline Carbothane 134 VOC
			SW Zinc Clad III HS-100		SW Macropoxy 646-100		SW Hi-Solids Polyurethane-100
Galvanized & Aluminum Semi-Gloss	N-7S	Primer	PPG 90-912 Series Pitt-Tech DTM Industrial Enamel		N/A	Acrylic Semi-Gloss	PPG Pitt-Tech Plus 90-1210
			Carboline Galoseal WB				Carboline Carbocrylic 3234
			SW Pro-Cryl Universal Primer				SW Pro Industrial B66-650
Plywood Semi-Gloss	PW-3S	Acrylic	PPG 9-900 Pure Performance Interior Latex Primer	Acrylic	PPG Speedhide 6-500	Acrylic Semi-Gloss	PPG Speedhide 6-500
			SW Wood Primer B28W8111		SW Pro Industrial B66-650		SW Pro Industrial B66-650
			Carboline Carbocrylic 120		Carboline 3234		Carboline 3234

Surface	System Designation	Primer	Manufacturer's Product	2nd Coat	Manufacturer's Product	Top Coat	Manufacturer's Product
Concrete Floor Clear Finish	CF-4	Epoxy	PPG MegaSeal HSPC 99-12700 Carboline Carboguard 1340 SW ArmorSeal 33 B58CQ33		N/A	Epoxy	PPG MegaSeal SL 99-12600 Carboline Sanitile 925 SW ArmorSeal 650 SL/RC Clear
Concrete Floor Color Finish	CF-5	Epoxy	PPG MegaSeal HSPC Carboline Carboguard 1340 SW ArmorSeal 33 B58 AQ33		N/A	Epoxy	PPG MegaSeal SL Carboline Sanitile 555 SW ArmorSeal 650 SL/RC
Concrete, Heavy Duty	C-5	Epoxy	Carboline Carboguard 1340 PPG PMC Amerlock Sealer	Epoxy	Carboline Carboguard 890 VOC PPG PMC Amerlock 400 VOC	Epoxy	Carboline Carboguard 890 VOC PPG PMC Amerlock 400 VOC
Concrete Masonry, Heavy Duty	CM-6	Epoxy block filler	Carboline Carboguard 954 HB	Epoxy	Carboline Carboguard 890 VOC		Carboline Carboguard 890 VOC

END OF APPENDIX "B"

DIVISION 9

SECTION 09913

PAINT REMOVAL AND REPAINTING METAL FABRICATIONS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for construction site removal of existing paint and coatings and field painting of items and surfaces listed in the Contract Drawings and Appendix C to this Section.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section, or appendices to this Section. The latest edition at the time of bid shall apply:

	American Society for Testing and Materials
ASTM C 136	Standard Method for Sieve Analysis Fine and Course Aggregates
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 521	Standard Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
ASTM D 523	Test Method for Specular Gloss
ASTM D 562	Standard Test Method for Consistency of Paints Using the Stormer Viscometer
ASTM D 1400	Standard Test Method for Non-Destructive Measurement of Dry Film Thickness of Non-Conductive Coatings Applied to a Non-Ferrous Metal Base
ASTM D 1475	Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products
ASTM D 1640	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
ASTM D 2244	Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinate
ASTM D 2369	Standard Test Methods for Volatile Content of Coatings
ASTM D 2371	Standard Test Method for Pigment Content of Solvent-Reducible Paints
ASTM D 2697	Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 3335	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D 4138	Standard Test Methods for Measurement of Dry Paint Thickness of Protective Coating Systems by Destructive Means
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages

ASTM D 4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D 4587	Practice for Conduction Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
ASTM D 4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives
ASTM E 11	Test Method for Wire-Cloth Sieves for Testing Purposes
	Code of Federal Regulations (CFR)
29 CFR 1926	Occupational Safety and Health Regulations for the Construction Industry
	The Society for Protective Coatings(SSPC)
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-AB 2	Specification for Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-PA 1	Shop, Field & Maintenance Painting
SSPC-PA 2	Measurement of Dry Paint Thickness with Magnetic Gages
SSPC-Paint 36	Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance Based
SSPC-SP 1	Solvent Cleaning
SSPC-SP 2	Hand Tool Cleaning
SSPC-SP 3	Power Tool Cleaning
SSPC-SP 7	Brush-Off Blast Cleaning
SSPC-SP 10	Near-White Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-SP 12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
SSPC-QP 1	Standard Procedure for Evaluating Qualificationsof Painting Contractors (Field Application to Complex Structures)
SSPC-QP 2	Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Hand and Power Tool Cleaned Steel
SSPC-VIS 4	Guide and Reference Photographs for Steel Surfaces Prepared by Water Jetting
SSPC-Guide 6	Guide for Containing Debris Generated During Paint Removal Operations

SSPC publications are hereby modified by deletion of all references to the American Arbitration Association within all articles relating to dispute resolution. For resolution of disputes, see the Form of Contract clause entitled "Authority of Chief Engineer."

Equipment and Coating Manufacturers' Published Instructions

United States Department of Labor, Material Safety Data Sheets (MSDS)

1.03 QUALIFICATIONS AND EXPERIENCE

A. The entity performing the Work of this Section, and the supervisor(s) and workers employed by such entity who will actually perform the surface preparation; surface preparation inspection; coating application and coating application inspection operations of this Section, shall have within five (5) years preceding the Authority's acceptance of the Contractor's Proposal successfully completed at least two contracts of on-site surface preparation which utilized abrasive blast cleaning surface preparation method and coating application on structural steel bridges which span a waterway.

B. The entity performing the Work of this Section shall maintain SSPC-QP1 and QP 2 Certifications at the time of bid and throughout the duration of the Contract.

1.04 SUBMITTALS

See Appendix A.

PART 2. PRODUCTS

2.01 MATERIALS

A. Coatings

1. Provide all paint or coating products in strict accordance with the requirements of the Contract Drawings, and Appendices A, C and D. Also provide the urethane top coat in a medium gloss (55 to 65 range).
2. The paint products for System S-1 shall be on the current Northeast Protective Coatings Committee (NEPCOAT) Qualified Product List. Compositional ranges and infrared spectra shall be the same as those accepted by NEPCOAT.
3. Provide finish coats in colors as selected by the Engineer, with underlying coats in contrasting colors.. The primer must be distinguishable from the blasted steel surface. Provide the intermediate coat in white or off-white. It is imperative that the finish coat be produced in the same color and gloss throughout the duration of the Contract. The allowed variation from the originally approved finish coat in color is +/- 1.0 dE (ASTM D 2244), and in gloss is +/- 5 units (ASTM D 523).
4. Provide all paint materials in sealed, original, containers that are properly marked and labeled to allow verification with applicable material safety data sheets, application precautions, and instructions. Verify that the labeling includes the manufacturer's name, type of material, brand name, color designation, date of manufacture, shelf life, contract or order number under which the material has been ordered, lot and batch numbers, quantity, handling, thinning, and application instructions, and gross, tare and net weights.
5. Provide certified test results for each paint batch.

B. Caulking

1. Provide caulking for application in all areas where existing pack rust is removed and in other areas designated by the Engineer.
2. Provide and use caulking material that is approved by the coating manufacturer, accepted by the Engineer, and that can be used successfully between the intermediate and finish coats.
3. Provide the caulking in the same color as the approved top coat.
4. Obtain the caulking from a single manufacturer for all Work of this Section.

C. Epoxy Pit Filling Material

1. Provide epoxy pit filling that is recommended by the coating manufacturer for use with its products.

2. Provide material that is compatible with the paint system, which is capable of filling pits that are 3/16 inch and deeper on surfaces in any orientation (e.g., horizontal or vertical), and which will perform under ponding water conditions. The pit filler must not affect the performance of the paint system when used between the prime and intermediate coats.

2.02 ABRASIVES

A. Provide expendable or recyclable abrasives that are dry and free of oil, grease, and corrosion producing, or other deleterious contaminants. Do not use silica sand.

B. Provide abrasives that are sized to produce a sharp, angular, uniform anchor pattern profile height of 2.0 to 3.5 mils, unless the requirements of the coating manufacturer are more restrictive. In this case, comply with the profile requirements specified by the coating manufacturer.

2.03 EQUIPMENT

A. Surface Preparation Equipment

1. Provide brushes, discs, wheels, scrapers, blast cleaning, and other surface preparation equipment sized properly to conduct the Work as specified in this Section.

2. When using recyclable abrasives, provide all equipment needed to recover and clean the abrasive for reuse in compliance with the requirements of this Section.

3. Provide specialized equipment as required for the cleaning of limited access areas as defined in 1.03 A and Appendix E, and for other difficult-to-clean areas. Specialized equipment may include, but is not limited to:

a. Power Washing Equipment with Specialized Nozzles - 0°, 30°, and 60° tips; round and flat jet nozzles, whirl jet nozzle, pipe and sewer nozzles; and others.

b. High pressure or ultra high pressure water jetting equipment.

c. Angled Nozzles (e.g. 45°, 90°, and 135°) or short nozzles for abrasive blast cleaning.

d. Spin blast equipment.

e. Power tool cleaning equipment with vacuum shrouds.

f. Specialized equipment for removing rust scale and pack rust, such as grinding wheels, and heavy duty vibrating and impacting power tools.

B. Paint Application Equipment

1. Provide paint brushes, rollers, and spray equipment to perform the Work as specified in this Section.

2. Provide specialized equipment as required for the painting of limited access areas as defined as defined in 1.03 A and Appendix E, and for other difficult-to-clean areas. Specialized equipment may include, but is not limited to:

a. Pole guns for spray painting.

b. Mits, daubers, or other methods to supplement brush application.

C. Containment, Worker, and Environmental Protection

1. Comply with Section 02095 which specifies the requirements for the installation and use of containment systems, for the protection of Contractor workers, the public, and the environment from harmful levels of dust, lead, and other toxic metals that may be present in the paint during removal, repair, and clean-up activities.
2. Provide containment materials and systems to provide similar levels of protection during all paint application activities, including the control of drips, spills, and overspray.

PART 3. EXECUTION

3.01 CONTAINMENT AND PROTECTION OF SURFACES

A. Comply with the specific requirements of Section 02095 for containment during the removal of the lead-containing paint. Apply all coatings within an enclosure designed to prevent the escape of paint debris and overspray.

1. Use extreme diligence to assure that vehicular traffic and permanent construction, equipment, hardware, fixtures, and other materials are protected against abrasive impact, paint spillage, overspray, and other damage.
2. Correct damage by cleaning, repairing or replacing, and repainting, as approved by the Engineer, all at no additional cost to the Authority.
3. Provide a paint cleaning station for the removal of drips or overspray from vehicles when painting work is performed above the roadway. Locate the station in an area selected by the Engineer. Utilize workers skilled in the restoration of paint damage, when required.

B. Provide "Wet Paint" signs as required to protect newly painted finishes.

C. Use protective coverings, shields, or masking as necessary to protect surfaces that are not designated to receive surface preparation or coating.

D. Maintain all protective coverings during the entire period the Work is being performed, and remove all coverings upon completion of the Work.

3.02 SEQUENCE OF OPERATIONS

A. Plan the painting operations and use all necessary tarpaulins/containment devices to assure that overspray from painting in adjacent or overhead areas does not become deposited on the prepared steel or between coats in another area.

3.03 TECHNICAL REPRESENTATION BY MATERIAL MANUFACTURERS

A. Arrange for a qualified technical representative of the paint manufacturer to periodically inspect the Work to verify that the quality of surface preparation is satisfactory for the coating system. Schedule the first visit to coincide with the pre-production test applications described in 3.04 A and Appendix B.

B. Arrange for a qualified technical representative of the approved caulking manufacturer to be at the construction site on the first day of field application of the caulking to verify compatibility of the caulking, and to approve the application procedures being used.

C. Arrange for additional visits by the qualified technical representatives, as requested by the Engineer.

D. Arrange for the manufacturers' representatives to summarize the results of the inspections in writing, together with recommendations. Provide 3 copies of the reports to the Engineer within one week.

3.04 SURFACE PREPARATION

A. Pre-Production Surface Preparation Test Areas

1. Prior to proceeding with production surface preparation operations, prepare test areas as defined in Appendix B.
2. Do not proceed with production surface preparation activities until the coating manufacturer accepts the results and the Engineer agrees that the test area(s) conform to the requirements of this Section.

B. Weld Spatter, Sharp Edges, and Holes

1. Remove slag, flux deposits, weld spatter, and surface irregularities such as slivers, tears, fins, and hackles. Grind any resulting burrs smooth, including burrs around holes.
2. Prior to surface preparation, break sharp edges, sharp discontinuities, and flame cut edges. The rolled edges of angles, channels, and wide flange beams do not normally require further rounding unless specifically required by the Engineer.
3. Avoid damaging welds or gouging the steel during these operations. Conduct the work in accordance with AWS Guidelines.

C. Rust Scale and Pack Rust

1. Rust scale is present in patches across the surface. There is also a considerable amount of pack rust present at built-up plates and connection areas.
2. Remove rust scale by hand and power tool chipping and grinding prior to blast cleaning.
3. Remove all loose pack rust and remove tight pack rust until the highest point is a minimum of 3 mm (1/8") below the surface of the surrounding sound steel. Pack rust that can not be removed by prying, probing, and digging with a dull putty knife is considered to be tight.
4. Exercise extreme care to avoid nicking or gouging the steel during removal. Nicks and gouges are cause for a suspension of activities until appropriate adjustments are made to prevent a reccurrence.
5. Caulk all pack rust areas (not rust scale areas that may be pitted) as part of the painting process.

D. Compressed Air Cleanliness

1. Provide compressed air that is free from moisture and oil contamination.
2. Use the white blotter test in accordance with ASTM D4285 to verify the cleanliness of the compressed air. Conduct the test at least once per shift for each compressor system. Sufficient freedom from oil and moisture is confirmed if soiling or discoloration are not visible on the paper.
3. If air contamination is evidenced, change filters, clean traps, add moisture separators or filters, or make adjustments as necessary to achieve clean, dry air. Reinspect surfaces prepared or coated since the last satisfactory test and repair, at no cost to the Authority, defective work caused by contaminated air.

E. Ambient Conditions - Do not perform surface preparation which exposes bare steel to damp environmental conditions, or when the surface temperature is less than 5° F greater than the dew point temperature of the surrounding air.

F. Remediation of Chloride

1. Develop surface preparation procedures and processes that will remove chloride from the surfaces in addition to removing paint, rust, and mill scale. Surfaces that may be contaminated with chloride include, but are not limited to, expansion joints and all areas that are subject to roadway splash or run off such as fascia beams and stringers, and truss members

2. Methods of chloride removal may include, but are not limited to, steam cleaning or pressure washing and scrubbing before or after initial paint removal, chloride removal additives, abrasive blast cleaning the steel and allowing it to rust overnight followed by reblasting, blast cleaning with blends of fine and coarse abrasives, or wet abrasive blast cleaning. Provide the proposed procedures for chloride remediation in the Surface Preparation/Painting Plan.

3. Upon completion of surface preparation, use field chloride extraction and test procedures (e.g., silver dichromate) approved by the Engineer, to test representative surfaces which were previously rusted (e.g., pitted steel) for the presence of remaining chlorides. For all steel perform a minimum of 10 tests per span. If unacceptable results are found, double the frequency for the retesting after additional cleaning. If acceptable results are continually achieved, reduce the test frequency only upon written approval of the Engineer. Record all test results in a daily log or daily report, submitted to the Engineer each seven calendar days.

4. If chlorides are detected at levels greater than 7µg/cm2, continue to clean the affected areas until acceptable results are achieved.

5. Following successful chloride testing of less than 7µg/cm2, abrasive blast and/or power tool clean the surfaces, as applicable, to achieve the required surface preparation criteria. For surfaces that have already been abrasive blast cleaned, SSPC-SP 11 may be used in lieu of SSPC-SP 10 for the localized cleaning of the chloride test areas upon approval of the Engineer.

G. Surface Preparation Requirements - Steel Substrates - The Contract Drawings and Appendix C identify the degree of cleaning required for various steel substrates. Comply with the following requirements for each of the specified degree(s) of cleaning:

1. SSPC-SP 1 Solvent Cleaning

   a. Prior to using power tools or dry abrasive blast cleaning, remove all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from bare steel in accordance with SSPC-SP 1.

   b. Only use solvents or detergents that are acceptable to the coating manufacturer and the Engineer.

2. SSPC-SP 2 Hand Tool Cleaning

   a. Use scrapers, putty knives, wire brushes, chipping hammers and other similar tools to thoroughly clean all surfaces as specified. Comply with the requirements of SSPC SP-2 to remove all loose mill scale, loose rust, loose paint, and other loose foreign matter.

   b. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered to be adherent if they cannot be removed by lifting with a dull putty knife.

c. SSPC-VIS 3 may be used as an aid in determining the quality of cleaning.

3. SSPC-SP 3 Power Tool Cleaning

a. Use power assisted hand tools such as sanding discs or 3M clean and strip discs, wire brushes, needle guns, or similar tools to thoroughly clean all surfaces specified. Comply with the requirements of SSPC SP-3 to remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter.

b. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

c. SSPC-VIS 3 may be used as an aid in determining the quality of cleaning.

4. SSPC-SP 7 Brush-Off Blast Cleaning

a. Thoroughly blast clean all surfaces as specified. Comply with the requirements of SP 7 to remove all visible oil, grease, dirt, dust, loose paint, and other foreign matter. SP7 is only used on newly applied coatings that require repair or overcoating after extended curing times. Verify that surfaces have been exposed to the abrasive and that the surfaces are densely and uniformly roughened.

b. It is not intended that adherent paint be removed by this process. Paint is considered adherent if it cannot be removed by lifting with a dull putty knife. Verify that the edges of paint are feathered.

c. Accomplish the SP 7 degree of cleaning using dry blast cleaning with recyclable or expendable abrasives, wet abrasive blast cleaning, water jetting with abrasive injection, or vacuum blast cleaning. If it is proposed that wet methods of preparation be used, provide a letter from the coating manufacturer which approves the use of the specific method for its coating system. Allow the surface to thoroughly dry prior to painting, and apply the primer before any visible rusting occurs.

d. SSPC-VIS 1 and the approved surface preparation test section may be used as an aid in determining the quality of cleaning. In the case of conflict between the written definitions and the visual standards or test sections, the written definitions prevail.

5. SSPC-SP 10 Near-White Blast Cleaning

a. Thoroughly blast clean all surfaces specified. Comply with the requirements of SSPC-SP 10 to remove all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Allow staining to remain on no more than 5 percent of each nine square inch increment of surface area.
Acceptable staining is limited to light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied paint.

b. Accomplish the SP10 degree of cleaning using dry blast cleaning with recyclable or expendable abrasives, wet abrasive blast cleaning, water jetting with abrasive injection, or vacuum blast cleaning. When using wet methods of preparation, incorporate an inhibitor into the cleaning process that is acceptable to the paint manufacturer to prevent flash rusting of the steel. Allow the surface to thoroughly dry prior to painting, and apply the primer before any visible rusting occurs.

c. When preparing thin gage steel such as utility boxes, use extreme care and adjust work practices as necessary (e.g., reduce pressures, decrease dwell times, and increase nozzle-to-work piece distances) to avoid warping or damaging the substrate.

d. SSPC-VIS 1 may be used as an aid in determining the quality of cleaning for the carbon steel.

6. SSPC-SP 11 Power Tool Cleaning to Bare Metal

a. Use power assisted hand tools such as needle guns, Roto peening equipment, or similar tools to thoroughly clean all surfaces specified. Comply with the requirements of SSPC-SP 11 to remove all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted.

b. Provide a surface profile of 1.0 to 2.5 mils on all prepared surfaces to be painted, unless the requirements of the coating manufacturer are more restrictive. In this case, comply with the profile requirements specified by the coating manufacturer.

c. SSPC-VIS 3 may be used as an aid in determining the quality of cleaning.

7. SSPC-SP 12 High and Ultra High Pressure Water Jetting

a. Use high pressure (10,000 to 25,000 psi) or ultra-high pressure water jetting (above 25,000 psi) in accordance with SP 12 to thoroughly clean all surfaces as specified.

b. When WJ-1 and SC-2 is specified, remove all coatings, corrosion, and mill scale, and chlorides to less than 7μg/cm2 (micrograms/square centimetre).

c. When WJ-2 and SC-2 is specified, remove all coatings, rust, and foreign matter with the exception of stains covering 5% of the surface area, and chlorides to less than 7μg/cm^2.

H. Abrasive Cleanliness and Analysis

1. For disposable abrasives, select a new, unused sample and conduct the water soluble contaminant and oil content tests outlined in SSPC-AB 1 for each shipment or lot before use and at least once each week. If the results do not comply with the SSPC criteria, stop using the abrasive and immediately notify the Engineer. Obtain a different lot of abrasive, and use it only if it passes the tests.

2. For recyclable abrasives, select a sample from each recycling machine in use and conduct the non-abrasive residue, water-soluble contaminant, and oil content tests outlined in SSPC-AB2 prior to initial use and at least once each week.

3. Conduct the lead content tests of the recycled abrasive at least once each month on a sample from each machine.

4. If the results of the recyclable abrasive tests do not comply with the SSPC criteria, notify the Engineer immediately, and remove and replace the abrasive and clean the recycling equipment. Conduct additional tests each day to confirm that the equipment is functioning properly. Return to the weekly testing intervals when authorized by the Engineer.

I. Surface Profile

1. For carbon steel, weathering steel, and stainless steel, provide a sharp, angular, uniform anchor pattern profile height of 2.0 to 3.5 mils, unless the requirements of the coating manufacturer are more restrictive.

2. When SSPC-SP 11 is specified, provide a surface profile of 1.0 to 2.5 mils, regardless of the substrate type. Provide a profile greater than 2.5 mils if required by the coating manufacturer and approved by the Engineer.

3. Measure the surface profile of blast cleaned surfaces using a Surface Profile Comparator or Testex Replica Tape in accordance with ASTM D4417. Measure the surface profile of power tool cleaned surfaces using the Testex Replica Tape.

3.05 PAINT STORAGE, MIXING, AND HANDLING

A. Authority Testing of Paint Samples

1. The Authority reserves the right to conduct tests of the materials at any time, and any number of times during period of field painting.

2. The Engineer will sample the paint(s) being used. A representative pint or quart sample of each component of paint(s) at the construction site will be transferred to metal containers, identified, sealed and certified in the presence of the Contractor.

3. Tests on paint samples may be conducted by the Port Authority of NY & NJ, Materials Engineering Division, to confirm manufacturer's test results submitted with each batch of material. Any or all of the tests outlined in Appendix A may be conducted.

4. If the laboratory test results show that the material being used does not comply with the requirements specified in this Section, the Contractor may be directed to stop painting Work and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; or remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

B. Paint Storage

1. Store all flammable materials in approved storage containers at locations approved by the Engineer. Do not store flammable materials directly underneath the elevated roadway or within fifty (50) feet of the elevated roadway foot print.

2. Store all paint, thinners, and solvents in accordance with OSHA regulations and the requirements of the paint manufacturer. Store the paint and solvents under cover, out of direct sunlight. Maintain the temperature between 40°F and 90°F, unless the requirements of the manufacturer are more restrictive. In this case, provide the manufacturer's requirements to the Engineer in writing for approval.

3. Provide the size and number of fire extinguishers in proper proportion to the quantity of paint stored.

4. Use explosion-proof lighting fixtures in the storage area.

5. Do not permit smoking in paint storage, mixing, and application areas.

6. Keep all containers of paint unopened until required for use.

7. Do not open or mix paints in the storage area.

8. Do not return mixed paints to the storage area.

9. Equip bulk containers for solvents and thinners with spring-loaded, self- closing, dispensing nozzles. Use Underwriter's Laboratories approved containers for transporting paint to mixing areas.

10. Do not permit the accumulation of empty paint cans, combustibles, and other debris. Remove waste chemical solutions, oily rags, and waste daily.

11. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.

12. Keep storage area neat and orderly.

13. Take all necessary precautionary measures to ensure that workmen and Work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of materials.

C. Mixing and Thinning of Coating Materials

1. Verify that the paint to be mixed has not exceeded its shelf life.

2. When required by the manufacturer, warm paints stored at less than 50°F to above 50°F prior to mixing.

3. Utilize proper ventilation in the mixing area to prevent injury to workmen or the accumulation of volatile gases.

4. Mix all coatings in accordance with the requirements of the coating manufacturer using mechanical equipment as appropriate, such as a Jiffy mixer, unless restricted by the manufacturer.

5. Mix only complete kits of multi-component materials or moisture-curing urethane. Mixing of partial kits or containers is not allowed.

6. Do not use two component materials beyond the pot life established by the manufacturer's written instructions.

7. Do not thin any paints unless approved in writing by the paint manufacturer and the Engineer. If thinning is required and authorized, use only those types, brands, and amounts of thinner stipulated by the coating manufacturer. Comply with state VOC limits after thinning.

8. Provide each coat of paint in a contrasting color to distinguish it from previously applied or existing coatings. Deliver paint ready mixed to approved tints and colors. Construction site tinting is prohibited.

3.06 COATING APPLICATION

A. General

1. Apply the coatings in accordance with the requirements of this Section, the coating manufacturer, and SSPC-PA 1.

2. In the event of a conflict between the manufacturer's technical data and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Engineer of the discrepancies in writing, and comply with the Engineer's written resolution.

B. Quality of Surface Preparation and Time Restrictions Prior to Painting

1. Verify that the surface exhibits the specified degree of cleaning immediately prior to painting. Reclean deficient areas.

2. Apply the prime coat on the same day (within 12 hours) that the substrate was cleaned to bare metal. If the bare substrate is allowed to remain uncoated for more than 12 hours, or rerusting is evident in the case of steel, reclean the surface prior to painting.

C. Pit Repairs

1. After the application and drying of the primer in accordance with the manufacturer's instructions, fill all pits 3/16 inch and deeper in all locations designated by the Engineer. Use the paint manufacturer's approved epoxy filler material.

2. Apply the epoxy filler material in strict accordance with the written instructions of the manufacturer. Work the material into the pits and strike flush with the surrounding surface in order to provide a smooth finish.

3. Do not apply the intermediate coat until the filler has dried for the length of time required by both the coating manufacturer and filler manufacturer.

D. Surface Cleanliness Prior to Painting and Between Coats

1. Do not perform paint application in areas where dust is being generated.

2. Thoroughly clean the surface of each coat prior to the application of the next to remove spent abrasive, dirt, dust, cement spatter, overspray, and other interference material. Pay particular attention to the removal of detrimental residue from surfaces such as corners and pockets and the sequencing of operations as specified in 3.02 to avoid the deposition of overspray on the bare steel or between coats.

3. Clean the surfaces by brushing, vacuuming, or blowing down with compressed air. Comply with Section 02095 for special restrictions on brushing and using compressed air for cleaning when removing paints that contain lead or other toxic metals.

4. If grease or oil have become deposited on the bare steel or on the surface of any of the applied coats, remove by solvent cleaning in accordance with SSPC-SP1 prior to the application of the next coat.

E. Containment During Application

1. Unless approved by the Engineer in writing, apply all coats within an enclosure, and maintain the enclosed environment within the temperature limits specified by the coating manufacturer during application and drying.

2. Provide continuous ventilation during all painting and drying activities to evacuate the solvent fumes to maintain a safe working environment, and to facilitate the evaporation of solvents for proper curing of the paint film.

3. When the painting enclosure is not weather-tight, do not apply paint when the U.S. Weather Bureau forecasts precipitation that would commence prior to the drying of the paint.

F. Ambient Conditions During Coating Application -Apply coatings under the following conditions unless the requirements of the coating manufacturer are more restrictive. Do not apply coatings under less restrictive conditions without written approval of the coating manufacturer, and specific written authorization from the Engineer.

1. Surface and Air Temperatures - Between 45°F and 100°F.

2. Relative Humidity - Less than 90%.

3. Dew Point - Surface temperature at least 5°F above the dew point temperature of the surrounding air.

4. Frost/Rain - Do not apply coatings to surfaces containing frost or free standing water, or during rain, fog, or similar detrimental weather conditions, unless the containment is designed to protect against such conditions.

5. Remove and replace any paint that is exposed to unacceptable conditions (e.g. rain or dew) prior to adequate curing.

G. Methods of Application - Apply all coats by the methods shown below, unless the methods recommended by the paint manufacturer are more restrictive. Keep all paint materials under agitation during application, unless restricted by the manufacturer.

1. Brush application - Use round or oval brushes. Use flat brushes only on large plate surfaces between connections, and only upon approval of the Engineer, except as identified below to supplement spray application of the primer. Brush apply the paint using a series of small circles to thoroughly fill in all surface irregularities, and end with a series of parallel strokes to smooth the finish. On vertical surfaces, make the final strokes vertically.
2. Roller application - Use rollers only on large plate surfaces between connections, and only upon approval of the Engineer. Select a nap size and roller quality that will properly wet the substrate and produce a smooth, uniform film. Apply the coating in such a manner as to achieve complete and thorough coverage of the surface and all irregularities. Back-roll the surface after application to create a smooth, uniform finish.
3. Daubers - On surfaces that are inaccessible for paint brushes, use sheepskins or daubers especially constructed for the purpose.
4. Airless or conventional spray application - Use airless or conventional spray, as appropriate for the coating material. If conventional spray is approved for use, verify that the compressed air supply is clean and dry as determined by the blotter test in accordance with ASTM D4285. When spraying, use extreme care to avoid contamination of surrounding areas or property by overspray. When spray applying the prime coat, use a brush to work the material into areas such as crevices, around lacing bars, and rivets.

H. Recoat Times

1. Apply each coat only after the previous coat has been allowed to dry as required by the manufacturer's written instructions, but as soon as possible to minimize the length of time that the coating is exposed to dust and contamination.
2. Do not allow any coat to remain exposed for longer than the time allowed by manufacturer's written instructions prior to overcoating, but in no case shall the time between coats be longer than 14 days.
3. If time between coats exceeds the manufacturer's maximum recoat times for any reason, remove and replace the coating. As an alternative, provide written instructions from the coating manufacturer for the specialized preparation that can be undertaken (e.g., scarifying the surface) to properly prepare the surface to receive the next coat. The specialized steps can be undertaken only if approved by the Engineer. Perform the specialized cleaning or removal and replacement of the coatings at no additional cost to the Authority.

I. Coverage, Continuity, and Stripe Coating

1. Apply each coat at the proper consistency in a workmanlike manner to assure thorough wetting of the substrate or underlying coat, and to achieve a smooth, streamlined surface free of dryspray, overspray, and orange peel. Shadow-through, pinholes, bubbles, blisters, fish eyes, skips, misses, lap marks between applications, or other visible discontinuities in any coat are unacceptable, and shall be repaired. Runs or sags may be brushed out while the material remains wet.
2. Thoroughly coat all surfaces with special attention to hard-to-reach areas, and irregular surfaces such as lacing bars, rivets and pitted steel. When coating configurations such as bolts and pits, apply the material from multiple directions to assure complete coverage. When spray applying the primer, use a brush to thoroughly work the material into these hard-to-reach and irregular surface areas.

3. For paint system S-1, apply stripe coats of the prime and finish coats to all edges, corners, welds, crevices, rivets, bolt threads, bolt heads, and other surface irregularities.

   a. Apply the stripe coat of primer before or after the application of the full prime coat. If applied before, allow the stripe coat to dry in accordance with the manufacturer's "dry to recoat" times prior to application of the full prime coat, but comply with the restrictions on the length of time that bare steel can remain uncoated after preparation, and comply with restrictions on re-rusting of the bare steel prior to coating. If applied after the full prime coat, allow it to dry prior to the application of the intermediate coat. The primer stripe coat shall be of contrasting color to the primer and intermediate coats.

   b. Apply the stripe coat of finish prior to the application of the full finish. Allow the stripe coat to dry for a minimum of 15 minutes prior to the application of the full finish to allow inspection personnel time to verify that it has been applied.

   c. Extend the stripe coats a minimum of one (1) inch from edges. The purpose of the stripe coats is to apply additional thickness and improve coverage on the irregular areas.

J. Caulking

1. After the application of the finish coat, apply caulking to all areas where pack rust has been removed.

2. Allow the caulking to dry in accordance with the manufacturers' instructions prior to the application of the finish coat.

K. Wet Film Thickness - Use wet film thickness gages in accordance with ASTM D4414 to verify the thickness of each coat at the time of application.

L. Dry Film Thickness

1. Apply each coat to the thicknesses specified by the coating manufacturers and as outlined in Appendix D. Notify the Engineer of any conflicts between the manufacturer's recommended dry film thickness, and the thickness shown in Appendix D. The decision of the Engineer will be final.

2. Give special attention to assure that surfaces such as edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Measure the thickness of each coat using nondestructive magnetic dry film thickness gages. Comply with SSPC-PA2 for the calibration and use of the gages, and the frequency of thickness measurements. Spot readings 80% of the specified minimum are permitted, provided the average thicknesses are within the specified tolerances. Do not exceed the maximum spot thicknesses provided in Appendix D (i.e., the SSPC PA2 allowance of 120% over the specified maximum thickness is not permitted).

4. Measure the thickness of each coat applied to non-ferrous metal substrates using nondestructive thickness gages in accordance with ASTM D1400.

5. If there are questions regarding the non-destructive measurements of coating thickness, a Tooke Gage (destructive scratch gage) may be used when authorized by the Engineer. Conduct measurements in accordance with ASTM D4138, but limit the use of the gage to a minimum of locations. Mark and repair all damage caused by the destructive testing, whether created by the Engineer or the Contractor.

6. Apply additional coating of the same type to areas of insufficient thickness. Use care during application to assure that all repairs blend in with the surrounding surfaces.

7. Unless directed otherwise by the Engineer in writing, remove excessive coating thickness and reapply the affected coat(s).

M. Coating Adhesion

1. Apply all coats in such a manner to assure that they are well-adhered to each other and to the substrate. If the application of any coat causes lifting of an underlying coat, or there is poor adhesion between coats or to the substrate, remove the coating in the affected area to adjacent sound, adherent, coating, and reapply the material.
2. If adhesion is suspect, conduct adhesion tests in accordance with ASTM D3359 or ASTM D4541 as directed by the Engineer, and repair all test areas. The acceptance criteria for the testing will be established by the Engineer and the coating manufacturer. Replace all defective coating that is revealed by the testing.

N. Paint System Requirements Before and After Winter Shut Downs

1. When coating operations are to be concluded for winter shutdowns, make certain that all primed surfaces receive the full intermediate and finish coats.
2. Terminate the painting with "tie in" areas consisting of a 6" step back of each successive paint application (i.e., leave a 6" band of primer exposed, and a 6" band of intermediate exposed).
3. Upon resumption of operations after winter shutdown, when abrasive blast cleaning the adjacent surfaces, prepare the 6" bands of exposed primer and intermediate, together with approximately 6" of the finish in accordance with SSPC-SP 7.
4. When painting the adjacent surface with the full coating system, overlap the primer onto the 6" band of primer, overlap the intermediate onto the 6" band of intermediate, and overlap the finish onto the 6" band of finish.

3.07 REPAIR OF DAMAGE AND UNACCEPTABLE COATINGS

A. Surface Preparation of Localized Areas

1. Repair localized damage, corrosion, and unacceptable coatings.
2. Prepare the surface by solvent cleaning in accordance with SSPC-SP 1 followed by power tool cleaning. Use a solvent that is acceptable to the paint manufacturer.
3. In areas previously blast cleaned, if the damage exposes the substrate, remove all loose material and prepare the steel in accordance with SSPC-SP 11.
4. In areas originally prepared by power tool cleaning, or if the substrate is not exposed in those areas previously blast cleaned, remove all loose material and prepare the surface in accordance with SSPC-SP 3. Use SSPC-SP 2 hand tool cleaning for surface preparation only upon written approval of the Engineer.
5. Follow the cleaning with a solvent wipe of the area.

B. Surface Preparation of Extensive Areas

1. Repair extensive areas of damage or unacceptable coating.
2. Prepare the surface by abrasive blast cleaning in accordance with SSPC-SP7, or better. The Engineer will stipulate the degree of blast cleaning required based on the nature of the defect.
3. Use extreme care to avoid damage to the surrounding coating due to overblast.

C. Feathering of Repair Areas

1. Feather the existing coating surrounding each repair location. Feather for a distance of 1 to 2 inches to provide a smooth, tapered transition into the existing intact coating.
2. Verify that the edges of coating around the periphery of the repair areas are tight and intact by probing with a putty knife in accordance with the requirements of SSPC-SP 3. Roughen the existing coating in the feathered area to assure proper adhesion of the repair coats.

D. Coating Application in Repair Areas

1. When the bare substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.
2. When the damage does not extend to the bare substrate, apply only the affected coats.
3. Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.

3.08 COMPLETED WORK

A. Match the completed Work with the approved samples for color, texture and coverage.

B. Remove, refinish or repair Work not in compliance with requirements specified in this Section.

3.09 HOUSEKEEPING AND WASTE DISPOSAL

A. Do not store any paint or equipment on or around bridge structures.

B. At the end of each day at a minimum, haul empty paint cans and other debris to the waste storage area.

C. Remove all paint drips, splashes, and overspray from surfaces not intended to be painted. Remove by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. Handle, store, transport, and dispose of all hazardous and non-hazardous project waste in strict accordance with Federal and state regulations. Comply with Section 02095 for waste handling, storage, transportation, and disposal.

3.10 IDENTIFICATION OF THE COATING SYSTEM

Stencil the following information on the bridge at the location(s) selected by the Engineer. Use a black urethane coating and provide lettering that is 4 inches in height.

A. Bridge Identification Number

B. Month and Year of Completion

C. Identification of Cleaning Method

D. Identification of Painting System

3.11 INSPECTION

A. The Engineer will inspect all phases of the Work to verify that it is in accordance with the requirements of this Section. Facilitate this inspection as required, including allowing ample time for the inspections and access to the Work. Inspections may include, but are not limited to, surface preparation, pre-painting cleanliness, paint application, dry film thickness, film appearance and continuity, and adhesion. Do not proceed with subsequent phases of the Work until the preceding phase has been approved by the Engineer.

B. The inspection by the Engineer in no way relieves the Contractor of the responsibility to comply with all requirements of this Section, and to provide comprehensive inspections of its own to assure compliance with the approved Quality Control Inspection Plan.

C. Furnish, until final acceptance of the coating system, all equipment and instrumentation needed to inspect all phases of the Work.

END OF SECTION

DIVISION 9

SECTION 09913

PAINT REMOVAL AND REPAINTING METAL FABRICATIONS

APPENDIX "A"

SUBMITTALS

1.01 GENERAL

Provide all submittals of this Appendix in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples," of Division 1, General Provisions. All submittals for coatings and construction materials shall be forwarded to the Manager, Materials Engineering Division, 241 Erie Street, Room 234, Jersey City, New Jersey 07310.

1.02 PRE-CONSTRUCTION

A. Contractor Qualifications, Experience, and Certifications - provide written qualification, experience, and certification information for the following:

1. Contractor - The Contractor shall submit documents to the Engineer providing evidence of the experience and qualifications of the Company and supervisors, and proof of SSPC-QP 1 and QP 2 certifications. Include the names, locations and telephone numbers of the owners of previously completed projects worked on by the Company and supervisory personnel.

B. Surface Preparation/Painting Plan

1. Provide written procedures for conducting the Work of this Section including, but not limited to, the preparation of surfaces; the remediation of chloride and ferrous salts; coating mixing, application, and repair; recoat times and cleaning between coats; and the installation of epoxy filler and caulking materials. Provide specific details for the preparation and painting of limited access areas, and for striping edges, corners, crevices, rivets, bolts, welds and sharp edges with both the prime and finish coats.
2. Provide a comprehensive listing of the equipment that will be used for surface preparation and painting. Include a description of equipment repair and replacement capability, including the procedures that will be followed in the event of equipment failure so that lost production time is kept to a minimum.
3. If temporary heating units are used, submit evidence of heating unit test acceptance by UL,FM or other recognized association and information related to the type of fuel used in such tests and to be used in Work of this Section
4. Identify the methods of protection or work isolation procedures that will be followed to protect surrounding structures, adjacent work areas, equipment, and property from exposure to surface preparation and paint overspray or debris.
5. Identify the name and chemical composition of detergents or solutions that will be used if it is necessary to clean the surface of one coat prior to the application of the next. Only detergents which are environmentally safe and which will have no adverse effect on aquatic life are acceptable. Submit the MSD Sheets for the chemicals and detergents. Use chemicals and detergents that are acceptable to the paint manufacturer.

6. Identify the type and brand name of the abrasives proposed for use. Provide MSD sheets for all abrasives.

7. If recyclable abrasives are used, identify the recycling equipment that will be used, including the methods for controlling the quality of the abrasive, and the abrasive cleaning and recovery procedures that will be employed.

8. If wet abrasive blast cleaning is proposed, include a letter from the coating manufacturer which recommends inhibitor(s) that can be used to prevent flash rusting, together with a statement that the inhibitor(s) will not reduce coating performance. Submit application procedures and MSD sheets for the inhibitor that will be used.

C. Worker Safety and Health

1. Comply with Section 02095 which specifies the requirements for the installation and use of containment systems for the protection of Contractor workers, the public, and the environment from harmful levels of dust, lead, and other toxic metals that may be present in the paint during removal, repair, and clean-up activities.

2. Submittal requirements for the protection of workers from lead and other toxic metals are found in Section 02095.

D. Coating Materials

1. Identify the coating materials to be applied to all substrate types as specified in Appendix C and the Contract Drawings.

   a. Confirm that all coating materials will be produced by the same manufacturer. The only exception to this requirement involves the use of penetrating sealers. If the selected coating manufacturer does not produce a penetrating sealer, another coating manufacturer's sealer may be used provided both manufacturers issue letters stating that the materials are compatible, and that the performance of the system will be at least equivalent to the performance of the same system produced by a single manufacturer.

   b. Provide the manufacturer's name, product names, product numbers, material product data sheets, VOC levels, and MSD sheets.

   c. Submit a letter from the coating manufacturer that acknowledges the acceptability of the specified systems for the various substrate types to be painted as identified in Appendices C and D. If the manufacturer does not agree with the specified systems, notify the Engineer in writing.

   d. Provide the following compositional ranges for each coat:

      (1) % Total solids by weight, ASTM D 2369

      (2) % Pigment by weight, ASTM D 2371

      (3) % Metallic zinc by weight of total solids in primer (using a dried film sample), ASTM D 521 and D 2369

      (4) % Total solids by volume, ASTM D 2697

      (5) Mass per volume (grams per liter), ASTM D 1475

      (6) Viscosity (Stormer @ 25°C) KU, ASTM D 562

      (7) Volatile Organic Compounds (VOC), ASTM D 2369

      (8) 60° Specular Gloss of finish coat, ASTM D 523

(9) Infrared Identification - of individual components and of the mixed coating for 2 component materials. For the individual components, obtain each spectrum by sandwiching a small quantity (i.e., 1-2 drops) of material between 2 potassium bromide plates and obtaining a transmission infrared spectrum. For the mixed and cured material, use a potassium bromide pellet technique.

e. Provide a copy of the test results for the finish coat in System S-1 to confirm that the finish coat meets the color and gloss performance criteria of SSPC Paint 36, Level 3, for accelerated weathering. After 2000 hours of accelerated weathering in accordance with ASTM D4587, the color change (ASTM D 2244) shall be less than 2.0 ΔE^* with a loss of gloss (ASTM D 523) less than 30.

f. Provide a written statement from the manufacturer that any paint to be used under Work of this Section contains not more than 0.06 percent lead.

2. Provide written application instructions from the manufacturer:

a. Address mixing and pot life requirements, specified thinners and thinner amounts, recommended application equipment, coating dry film thickness, and recoat times as a function of surface and air temperature.

b. Include a statement that the manufacturer accepts the 2.0 to 3.5 mil surface profile specified in this Section for abrasive blast cleaning, and the profile requirements for their product when SSPC-SP 11 is specified.

If the manufacturer requires a more restrictive profile range (e.g., 1.5 to 2.5 mils), provide the recommendations in writing from the manufacturer. Include any unique requirements from the manufacturer when coating to 3.5 mils profiles, such as the application of a thin mist coat prior to the application of the full prime coat.

3. Provide the following paint samples

a. Six (6) samples of paint and coating on 8 ½ inch x 11 inch paper board with textures to simulate actual conditions.

b. Paint and coating samples roller applied on 24 inch x 24 inch hardboard, stepped back 2 inches to show all layers of paint, with textures to simulate actual conditions.

c. Submit the samples in colors as selected by the Engineer

d. Identify each sample as to manufacturer, color name, and Federal Standard color number. Provide the gloss readings for the finish coats.

e. Submit coating samples to the Engineer.

4. In the event of a conflict between the manufacturer's technical data and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Engineer of the discrepancies in writing, and comply with the Engineer's written resolution.

E. Caulking and epoxy pit filling materials

1. Provide the name, generic type, and MSDS for the proposed caulking and epoxy pit filling materials.

2. Include a letter from the coating manufacturer stating acceptance of the caulking and epoxy pit filling materials for use with the coating system, and the specific sequence for the application of the materials.

3. Provide letters from the caulking and epoxy manufacturers stating that the materials are suitable for the intended use.

4. Provide written application instructions from the caulking and epoxy manufacturers. Include the type of equipment needed for application, mixing and application procedures, temperature and weather restrictions for application and curing, thickness requirements, and drying times for overcoating or exposure to weather.

5. In the event of a conflict between the manufacturer's technical data and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Engineer of the discrepancies in writing, and comply with the Engineer's written resolution.

F. Quality Control Inspection Plan
Submit a quality control inspection plan that will be followed to confirm that all Work complies with the requirements of this Section. The plan must include the following at a minimum:

1. Inspection organization chart including lines of authority and the experience, training, and qualifications of all quality control personnel.

2. Written inspection procedures for all phases of the Work, including the frequency of inspections that will be performed, and the handling of non-conforming work.

3. Documentation procedures including samples of the actual inspection forms that will be used for Work of this Section.

4. Written description of equipment to be used for surface preparation and coating application inspection, chloride detection, calibration procedures, frequency of calibration, and the methods for handling equipment that is found to be out of calibration.

1.03 CONSTRUCTION START-UP

A. Surface Preparation, Paint Application, and Inspection Demonstration - Prior to performing Work of this Section, perform sample cleaning, painting and quality control demonstrations indicated in Appendix B of this Section.

1.04 CONSTRUCTION PHASE

A. Paint Material Batch Certifications

1. Provide the following test results for each batch:

   a. % Total solids by weight, ASTM D 2369
   b. % Pigment by weight, ASTM D 2371
   c. For organic zinc primers only – % Metallic zinc by weight of total solids in primer (using a dried film sample), ASTM D 521 and D 2369
   d. % Total solids by volume, ASTM D 2697
   e. Mass per volume (grams per liter), ASTM D 1475
   f. Viscosity (Stormer @ 25°C) KU, ASTM D 562
   g. For finish coats only – Gloss, ASTM D 523 and color, ASTM D 2244

2. Do not allow the paint to be shipped or used until the above documentation has been received and approved in writing by the Engineer.

B. Material Manufacturer's Site Reports

1. Submit to the Engineer, 3 copies of the field summary reports prepared by the coating and caulking manufacturers upon completion of each site visit.

2. Provide each report within 1 week after the visit.

C. Recycled Abrasive Cleanliness Tests

1. Submit to the Engineer, 3 copies of the test reports on the cleanliness of recycled ferrous metallic abrasive.
2. Submit the reports within one (1) day after the completion of the weekly analysis. Include the daily test results in the weekly package.

D. Inspection Log or Report

1. Maintain a daily log or daily report of all quality control inspections and test results in compliance with the approved Quality Control Inspection Plan.
2. Submit a copy of the log or report form package to the Engineer each seven calendar days.

END OF APPENDIX A

DIVISION 9

SECTION 09913

PAINT REMOVAL AND REPAINTING METAL FABRICATIONS

APPENDIX B

PRE-PRODUCTION QUALITY EVALUATIONS

1.01 FIELD SAMPLES AND TESTS

A. Perform the following operations for approval at the specific location or locations specified herein or as selected by the Engineer:

1. Paint Colors - As selected by the Engineer.
2. Removal of Existing Coating - After erection of containment enclosure in accordance with Specification Section 02095, perform surface preparation operations of not less than a total of ninety (90) square feet on all surfaces and components of stringers, floorbeams, girders, diaphragm braces and limited access areas, and complete cleaning of one bearing shoe to demonstrate surface preparation methods and procedures to be used for the Work of this Section, consistent with the specified surface profile requirements.
3. Paint Application Procedures - After completion of surface preparation, demonstrate the application of the complete paint system on all surfaces and components, including stripe coats. Utilize all application procedures and methods that will be used for the Work of this Section, including a demonstration of the striping of bolts, nuts and edges.
4. Inspection Procedures - Demonstrate all inspection steps outlined in the approved Quality Control Inspection Plan including, but not limited to, monitoring of ambient conditions, compressed air cleanliness, surface preparation cleanliness and profile, coating mixing and thinning, coating application, measurement of paint application thickness and uniformity of application, cleanliness and drying time between coats, and final acceptance inspections.

B. Samples described in 1.01A.2 above, when approved by the Engineer, may be incorporated into the Work, and shall be used to establish the standard for surface preparation, color, and workmanship for the remainder of the Work of this Section.

END OF APPENDIX B

DIVISION 9

SECTION 09913

PAINT REMOVAL AND REPAINTING METAL FABRICATIONS

APPENDIX C

SURFACE PREPARATION, PAINT AND COATING APPLICATION SCHEDULE

1.01 Surface Preparation/Paint System Descriptions

System #1 - This is the predominant system for use on the bridge. It applies to all surfaces being painted. Surface preparation shall be SSPC-SP10 "Near White Metal" blast cleanliness, followed by application of an organic zinc rich primer, epoxy intermediate coat, and polyurethane finish coat. Stripe coats of the primer and finish are also applied.

Paint Schedule

System Surface	Designation	Primer	2nd Coat	3rd Coat
Structural Steel, Steel Conduit, Steel Electrical Boxes and Panels	S-1	Organic Zinc- Rich Primer	Epoxy	Polyurethane

END OF APPENDIX C

DIVISION 9

SECTION 09913

PAINT REMOVAL AND REPAINTING METAL FABRICATIONS

APPENDIX D

ACCEPTABLE MANUFACTURERS

SYSTEM S-1 ORGANIC ZINC RICH PRIMER/EPOXY INTERMEDIATE/ POLYURETHANE FINISH*

***PAINT SYSTEM S-1 MUST BE ON THE CURRENT NEW ENGLAND PROTECTIVE COATINGS (NEPCOAT) QUALIFIED PRODUCT LIST.**

		DFT (mils)	
		Range	**Spot Max**
	CARBOLINE COMPANY		
Primer	Carboline 859 Zinc Rich Epoxy Primer	3.5-5.0	8.0
2nd Coat	Carboline 888 Epoxy	4.0-8.0	10.0
3rd Coat	Carbothane 133LH Polyurethane	3.0-4.0	5.0
	SHERWIN WILLIAMS		
Primer	Zinc Clad III HS	3.5-5.0	6.5
2nd Coat	Macropoxy 646	5.0-8.0	10.0
3rd Coat	Acrolon 218 HS	3.0-4.0	5.0
	PPG/AMERON		
Primer	Amercoat 68 HS	3.5-5.0	6.5
2nd Coat	Amercoat 399	4.0-8.0	10.0
3rd Coat	Amercoat 450 HSG	3.0-4.0	5.0

DIVISION 10

SECTION 10210

METAL WALL LOUVERS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for fixed and adjustable extruded aluminum wall louvers, wall vents and accessories.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Architectural Manufacturers Association (AAMA)

AAMA 611	Voluntary Specification for Anodized Architectural Aluminum.
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

Air Movement and Control Association International, Inc. (AMCA)

AMCA 500L	Laboratory Methods of Testing Louvers for Rating.
AMCA 501	Application Manual for Air Louvers.

American Society for Testing and Materials (ASTM)

ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM C612	Specification for Mineral Fiber Block and Board Thermal Insulation.

American Welding Society, Inc. (AWS)

AWS D1.2	Structural Welding Code – Aluminum.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual for Architectural and Metal Products.

National Electrical Manufacturers Association (NEMA)

Technical Standards.

Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)

Architectural Sheet Metal Manual.

The Society for Protective Coatings (SSPC)

SSPC-Paint 12 Paint Specification No. 12 – Cold-Applied Asphalt Mastic (Extra Thick Film).

Underwriters Laboratories Inc. (UL)

Fire Resistance Directory.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Louver Terminology

Refer to AMCA International's publication AMCA 501 for definitions of terms for metal louvers not otherwise defined in this section or to referenced standards.

B. Structural and Thermal Performance

Installed exterior metal wall louvers shall withstand the effects of loads and stresses from wind and normal thermal movement without evidence of permanent deformation of louver components including blades, frames and supports; without noise or metal fatigue caused by louver blade rattle or flutter; and without permanent damage to fasteners and anchors.

1. Wind Load: Withstand wind loading based on uniform pressures shown on the Contract Drawings, acting inwards or outwards. Louvers shall resist minimum wind loading required by the New York City Building Code or by the New Jersey Uniform Construction Code (all as though the Authority were a private corporation) as applicable to where the Project is located.
2. Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.
   a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

C. Air Performance and Water Penetration Ratings

Louvers shall comply with the following performance requirements, as demonstrated by testing manufacturer's stock or custom fabricated units identical to those furnished and installed, unpainted, clean and degreased units without screens, of height and width indicated, in accordance with AMCA 500L.

1. Free area shall not be less than 45 percent on a 48 inch by 48 inch sized louver.
2. Static pressure drop shall not be more than 0.14 inch of water gage at an airflow of 900 fpm free area velocity.
3. Water penetration shall not be more than 0.01 oz. per sq. ft. of free area at an intake airflow of 900 fpm free air velocity when tested for 15 minutes.
4. Louvers shall be licensed to bear, and shall display, AMCA International's Certified Rating Seal.
5. Wind-Driven Rain Performance: Not less than 100 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s) at a core-area intake velocity of 690 fpm (3.5 m/s). Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches (200 mm) per hour and a wind speed of 50 mph (22 m/s) at a core-area intake velocity of 690 fpm (3.5 m/s).

D. Air Leakage Ratings (adjustable louvers only)

Adjustable louvers shall also comply with performance requirements indicated for air leakage as tested in accordance with AMCA 500L:

1. Air leakage shall not be more than 1.5 cfm per sq. ft. of gross face area that will pass through the louver at static pressure differential of 0.15 inch of water gage, with louver blades in the closed position.
2. Louvers shall be licensed to bear, and shall display, AMCA International's Certified Rating Seal.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A", submit structural calculations for louvers, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

B. Engineer Qualifications

Use the services of a professional engineer legally authorized to practice in the jurisdiction where the Work is located. Engineer shall be experienced in providing engineering services of the kind indicated which have resulted in the successful installation of louvers similar to Work of this Section in material, design and extent, and shall have a record of successful in-service performance.

C. Fabrication Standards

Comply with applicable provisions of SMACNA's *Architectural Sheet Metal Manual* for fabrication, construction details and installation procedures, except as otherwise shown on the Contract Drawings.

D. Welding Standards

1. Comply with applicable provisions of AWS D1.2 *Structural Welding Code – Aluminum.*
2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and has undergone recertification if pertinent.

E. Motor Standards

For motor-operated adjustable louvers, motors and related components shall be listed and labeled by UL and shall comply with applicable NEMA standards.

F. Single Source Responsibility

Obtain louvers and vents through one source from a single manufacturer.

G. Field Measurements

Check actual louver openings by accurate field measurements before fabrication and show recorded measurements on final Shop Drawings. Coordinate field measurements and Shop Drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of one of the following:

Architectural Louvers., Cincinnati, OH

Airline Products Co., Hagerstown, MD

The Airolite Co., Marietta, OH

American Warming and Ventilating Co., Holland, OH

Construction Specialties, Inc., Cranford, NJ

Industrial Louvers Inc., Delano, MN

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5, T6 or T52, or alloy 6061-T6.

B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by louver manufacturer for required finish.

C. Fasteners: Use same material as items fastened, except fasteners for exterior applications may be hot dip galvanized, stainless steel or aluminum. Types, gages and lengths shall suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners.

D. Anchors and Inserts

1. Use non-ferrous metal or hot-dip galvanized steel anchors. Inserts shall be steel or lead expansion bolt devices for drilled-in-place anchors.
2. Furnish inserts to be set into concrete or masonry, or furnish flat or angle type wall anchors where shown on the Contract Drawings.

E. Bituminous Paint: Cold-applied, asphalt mastic complying with SSPC-Paint 12 containing no asbestos fibers.

2.03 ACCESSORIES

A. Louver Screens

Removable screens for exterior louvers shall be as follows:

1. Frames
   a. Same material and finish as louver unit to which secured. Aluminum frames shall have mitered corners with clips.
   b. Rewireable, consisting of formed or extruded metal with a driven spline or insert for securing screen mesh.
2. Bird screens shall be 1/2 inch square mesh, of 0.063 inch diameter aluminum wire.
3. Insect screens, if any, shall be 18 by 18 mesh, of 0.009 inch diameter stainless steel wire.

B. Sill Extensions or Loose Sills

Same material and finish as louvers, where shown on the Contract Drawings or where required for drainage to exterior and to prevent water penetrating to interior.

2.04 FABRICATION

A. General

1. Fabricate louvers, blank-off panels, wall vents and accessories of design, dimensions, materials, arrangement and metal finish as shown on the Contract Drawings and as specified in this Section.
2. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly match-mark units for reassembly and coordinated installation.
3. Frames, including integral sills, shall suit adjacent construction with tolerances for installation, including for application of sealants in joints between louvers and adjoining Work.
4. Include supports, anchorages and accessories required for complete assembly, including metal framing.
5. Locate screens on inside face of louver, secure screen to louver frame with machine screws spaced a maximum of 6 inches from each corner and 12 inches o.c. between corner fasteners.
6. Join frame members to one another and to fixed louver blades by welding, except where field bolted connections between frame members are made necessary by size of louvers.
7. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
8. Louver Materials

   Minimum 0.125 inch thick aluminum extrusions for blades, frames and mullions, if any.

   a. Louver Frames

      Louver frames of size and depth shown on the Contract Drawings and as specified herein.

   b. Louver Blades

      Horizontal fixed or adjustable blades of profile, slope and spacing shown on the Contract Drawings and as specified herein.

   c. Mullions

      Vertical mullions shall be of types and at spacings shown on the Contract Drawings but not further apart than recommended by manufacturer or 72 inches on center, whichever is less. Furnish and install horizontal mullions at horizontal joints, if any, between louver units, except where continuous vertical assemblies are shown.

B. Fixed, Extruded Aluminum Wall Louvers

Fixed louvers shall be of extruded aluminum, with aluminum screens as shown on the Contract Drawings, and as follows:

1. Louver Depth: As shown on the Contract Drawings.
2. Blade Angle: Manufacturer's standard (40-45 degrees), or as shown on the Contract Drawings.
3. Blade Type: Drainable.
4. Screen Type: Bird screen.

C. Adjustable-Blade, Extruded Aluminum Wall Louvers

Adjustable-blade louvers shall be of extruded aluminum, with blade and jamb gaskets, with aluminum screens if shown, with manufactuer's recommended bearings and operating mechanisms to suit louver sizes shown on the Contract Drawings and prewired for motor operation, if any, as described below.

1. Louver Depth: As shown on the Contract Drawings.
2. Preset Blade Angle: Manufacturer's standard (40-45 degrees), or as shown on the Contract Drawings.
3. Blade Type: Drainable.
4. Screen Type: Bird screen.
5. Motor Operation: With 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver), 120-V, 60-Hz motor and limit switches, wired for grounding and equipped as follows:
   a. Terminals for controlling devices.
6. Adjustable-Blade Accessories
   a. Furnish and install snap-on, blade-edge gaskets for each louver blade to reduce air leakage at blade edges.
   b. Furnish and install metal jamb seals between adjustable-blade ends and jambs to restrict air leakage.

D. Drainable Blades

Fixed or adjustable louver blades shall be drainable type, designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

E. Blank-Off Panels

Laminated metal-faced panels, if any, shall consist of an insulating core, surfaced on back and front with metal sheets, finished to match louver, and shall comply with the following requirements:

1. Panel Thickness: 2 inches, or as otherwise shown on the Contract Drawings.
2. Metal Facing Sheets: Aluminum sheet 0.032 inch thick.
3. Insulating Core: Unfaced rigid glass fiber board insulation complying with ASTM C 612, Class 1 and 2.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded aluminum channel frames (provided they are minimum 0.063 inch thick) with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with 1/8 inch by 1 inch polyvinyl chloride compression gaskets.

F. Wall Vents (Brick Vents)

Extruded aluminum wall vents shall comply with the following requirements:

1. Minimum 0.125 inch thick extruded aluminum louvers and frames, welded assembly; incorporating weep holes, continuous drip at sill and integral water stop on inside edge of sill; with 18 by 14 mesh aluminum wire insect screening secured to inside face of wall vent.

2. Dampers: Equip wall vents with dampers where shown on the Contract Drawings. Dampers shall consist of aluminum blades and frame mounted on inside of wall vent; operated from exterior with allen wrench in socket head cap screw. Operating mechanism components shall be Type 304 stainless steel.

2.05 SHOP FINISHING

A. General

1. Comply with NAAMM's Metal Finishes Manual for Architectural and Metal Products for finish designations and application recommendations. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes listed in the NAAMM manual.
2. Factory apply finish to exposed metal surfaces after products are assembled.
3. Remove visible scratches and blemishes from exposed surfaces after completing finishing process. Protect finishes on exposed surfaces prior to shipment with protective coating.
4. Match colors shown on the Contract Drawings or match color sample, if any. If not shown, color shall be as selected by the Engineer from manufacturer's standard colors.

B. High Performance Organic Coating

AA C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals, prepared with an acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Ensure that coating is applied in strict accordance with coating manufacturer's instructions by a licensed applicator.

1. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene resin by weight; complying with AAMA 2605-11. Color and gloss as shown on Contract Drawings.
2. Subject to compliance with requirements, fluoropolymer coating systems shall contain resins produced by Atofina Chemicals, Inc. ("Kynar 500") or Solvay Solexis, Inc. ("Hylar 5000").
3. Furnish manufacturer's written warranty covering failure of the fluoropolymer coating system for a period of twenty (20) years after the date of Final Completion.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION

A. Install louvers and structural supports and attachment brackets as shown on the Contract Drawings and as required for a complete and proper installation.

B. Locate and place louver units plumb, level and in proper alignment with adjacent Work.

C. Use concealed anchorages. Use brass or lead washers fitted to screws to protect metal surfaces, where required, and to make weathertight connections.

D. Form closely fitted joints with exposed connections accurately located and secured. Provide perimeter reveals and openings of uniform width to accommodate sealants and joint fillers.

E. Install concealed gaskets, flashings, joint fillers and insulation, as louver installation progresses where required to make louver joints weathertight. Comply with Division 7 Section on Sealants, for sealants applied during installation of louvers.

F. Install bird screens, insect screens and blank-off panels, if any, as shown on the Contract Drawings.

G. Install wall vents, including supplementary framing or lintels as required, in accordance with manufacturer's instructions. Build vents into masonry walls with mortar as part of masonry construction. Install vents in other wall openings as shown on the Contract Drawings in accordance with approved Shop Drawings.

H. Protect aluminum surfaces from corrosion or galvanic action by application of a heavy coating of SSPC-Paint 12 bituminous paint on surfaces that will be in contact with concrete, masonry or dissimilar metals.

3.03 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and joining. Restore finishes so there is no evidence of corrective work. Return items to the shop that cannot be refinished in field, make required alterations and refinish entire unit, or furnish and install new units.

C. Periodically clean exposed surfaces of louvers and vents, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.

D. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry. Remove temporary coverings.

END OF SECTION

SECTION 10210

METAL WALL LOUVERS

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

For each louver type shown, including catalog cuts showing material types, thicknesses, appropriate AMCA certified rating seal and performance data, and product data for each accessory shown.

B. Shop Drawings

1. For louvers and accessories including plans, elevations, sections, and details showing profiles, angles, and spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; profiles of frames at jambs; heads and sills; anchorage details and locations. Indicate materials, finishes, fasteners, joinery and other information to determine compliance with specified requirements.
2. Wiring diagrams detailing wiring for power and control systems; differentiate clearly between manufacturer-installed wiring and field-installed wiring, where motorized adjustable louvers are shown on the Contract Drawings.

C. Samples

Submit 6 inch square samples of each required finish. Prepare samples on metal of same gage and alloy to be used in Work. Where normal color and texture variations are to be expected, such samples shall show limits of such variations.

D. Certifications

Product test reports evidencing compliance of units with performance requirements.

E. Design Calculations

Structural analysis data for installed products indicated to comply with certain design loadings, sealed and signed by the qualified professional engineer who was responsible for their preparation.

F. Qualifications

1. Professional Engineer: Demonstrate capabilities and experience. Include list of completed projects with project names, addressees, names of architects and owners.
2. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

DIVISION 10

SECTION 10430

ARCHITECTURAL SIGNAGE SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

A. Work of this Section shall include labor, tools, materials, equipment and services required to engineer, fabricate, construct, pack, ship and install Authority-designed signs, including, but not limited to graphics and sign components as shown on the Contract Drawings, as specified herein and as required to furnish and install a complete installation.

B. This Section includes the following sign types:

1. Interior
   a. Ceiling mounted single face and double face signs.
   b. Wall mounted signs and plaques.
   c. Pylon signs (free-standing signs).
2. Exterior
   a. Roadway signs.
   b. Post and panel signs.
   c. Suspended and wall mounted signs.
   d. Pylon signs (free-standing signs).

C. Coordinate Work of this Section with trades providing structural support systems to which the signs are attached, and cooperate with such trades to assure the steady progress of Work of this Section.

1.02 REFERENCES

A. The following is a listing of the publications referenced in this Section:

<u>American Architectural Manufacturers Association (AAMA)</u>

AAMA 611	Voluntary Specification for Anodized Architectural Aluminum.
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

<u>American Association of State Highway and Transportation Officials (AASHTO)</u>

AASHTO LTS-4	Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

<u>American Society for Testing and Materials (ASTM)</u>

ASTM A 167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
ASTM A 424	Specification for Steel Sheet for Porcelain Enameling.

ASTM A 591	Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications.
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM A 1008	Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B 221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM C 283	Test Method for Resistance of Porcelain Enameled Utensils to Boiling Acid.
ASTM C 297	Test Method for Flatwise Tensile Strength of Flat Sandwich Constructions.
ASTM C 346	Test Method for 45-deg Specular Gloss of Ceramic Materials.
ASTM C 481	Test Method for Laboratory Aging of Sandwich Constructions.
ASTM C 538	Test Method for Color Retention of Red, Orange and Yellow Porcelain Enamels.
ASTM D 256	Test Method for Determining the Izod Pendulum Impact Resistance of Plastics.
ASTM D 523	Test Method for Specular Gloss.
ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D 1003	Test Method for Haze and Luminous Transmittance of Transparent Plastics.
ASTM D 1044	Test Method for Resistance of Transparent Plastics to Surface Abrasion.
ASTM D 2244	Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
ASTM D 4802	Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
ASTM G 154	Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

American Welding Society (AWS)

AWS D1.1	Structural Welding Code, Steel.
AWS D1.2	Structural Welding Code, Aluminum. Standard Code for Arc and Gas Welding in Building Construction.

Flat Glass Marketing Association (FGMA)

Sealant Manual.

Glass Association of North America (GANA)

Glazing Manual.

Military Specifications

DOD-P-15328D	Primer (Wash), Pretreatment (Formula No. 117 for Metals).

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual for Architectural and Metal Products.

National Fire Protection Association

NFPA 70	National Electrical Code.

Porcelain Enamel Institute (PEI)

PEI-1001	Specifications for Architectural Porcelain Enamel.

The Society for Protective Coatings (SSPC)

SSPC-Paint 12	Paint Specification No. 12 – Cold Applied Asphalt Mastic (Extra Thick Film).
SSPC-Paint 20	Paint Specification No. 20 – Zinc-Rich Primers (Type I, "Inorganic" and Type II, "Organic").
SSPC-SP 1	Surface Preparation Specification No. 1 – Solvent Cleaning.
SSPC-SP 5	Surface Preparation Specification No. 5 – White Metal Blast Cleaning.
SSPC-SP 8	Surface Preparation Specification No. 8 – Pickling.

B. Comply with the following codes and standards to the extent that they would apply if the Authority were a private corporation:

1. American Institute of Graphic Arts (AIGA) guidelines.
2. The Americans with Disabilities Act Accessibility Guidelines (ADAAG).
3. Building Code of the City of New York for New York City contracts.
4. National Fire Protection Association (NFPA) regulations.
5. New Jersey Uniform Construction Code for New Jersey contracts.
6. Occupational Safety and Health Act (OSHA) standards.
7. Society for Enviornmental Graphic Design (SEGD) Sourcebook.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

When required by Appendix "A" of this Section, submit design calculations for sign panels and structural supports, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

1. Structural supports shall be capable of carrying total supported load (including sign, hangers, and attachments) and specified live, wind and earthquake loads.
2. Exterior sign design shall allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 degrees F. Base design on actual surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
3. Sign assemblies shall be designed to prevent buckling, opening up of joints and overstressing of welds and fasteners.

B. Interior Signage

1. Wind Gust Loads

Interior signs located in the entrance lobbies, entrance vestibules or boarding platforms of transportation terminals shall be designed for an incidental wind gust pressure of 15 psf. All other interior signs shall be designed for a minimum lateral pressure of 5 psf.

2. Earthquake Loads

Interior signs shall also be designed for earthquake loads per the applicable local building code, as though the Authority were a private corporation.

3. Live Load

Signs which require routine cleaning or servicing (i.e. variable message, internally illuminated, etc.), whether or not specifically designed for a servicing device, shall be designed for all anticipated additional loads, but not less than a 100-lb. concentrated horizontal load and a 300-lb. concentrated vertical load simultaneously applied at the point of assumed or most eccentric loading. The additional concentrated loads shall be calculated in combination with the sign dead load (not concurrent with wind or earthquake loads).

C. Exterior Signage

1. Wind Load

Exterior signs adjacent to vehicular traffic such as streets, highways, trains and light rail vehicles, or in open terrain, shall be designed in accordance with AASHTO LTS-4. All other exterior signs shall be designed per the applicable local building code, as though the Authority were a private corporation.

2. Live Load

Signs which require routine cleaning or servicing (i.e. variable message, internally illuminated, etc.), whether or not specifically designed for a servicing device, shall be designed for all anitcipated additional loads, but not less than a 100-lb. concentrated horizontal load and a 300-lb. concentrated vertical load simultaneoulsy applied at the point of assumed or most eccentric loading. The additional concentrated loads shall be calculated in combination with the sign dead load (not concurrent with wind or earthquake loads).

D. Connection Support

Sign support structures shall be directly connected to structural elements such as structural steel or structural concrete. Connections shall not be made to architectural, mechanical or electical components.

1.04 QUALITY ASSURANCE

A. Ensure that entities performing the fabrication and installation Work of this Section have ten (10) years experience in the fabrication and installation of signage involving complexities equal to or greater than those required for the Work of this Section.

B. Completed Work shall be structurally sound and free from scratches, abrasions, distortions, chips, breaks, blisters, holes, splits and other disfigurement considered as imperfections for the specific material.

C. Uniformity of Manufacture: For each sign type shown on the Contract Drawings furnish products of a single manufacturer.

D. Upon request arrange for the Engineer to inspect the sign fabrication facilities to observe fabrication of Work of this Section to ensure conformance to Contract Document requirements. Refer to Division 1 - General Provisions, Article entitled "Inspections and Rejections".

E. Mock-ups

1. Where shown on the Contract Drawings, supply one mock-up of each sign type shown. Mock-ups shall serve as quality standards for the Work of this Section.
2. Install mock-ups at locations identified by the Engineer.
3. Equip illuminated mock-ups with specified luminaries, switches and ballasts and make the mock-ups fully operational.
4. Construct mock-ups to the level and degree of fabrication and finish proposed for Work of this Section. Mock-ups, if approved by the Engineer, may be installed on site as part of the Work.
5. Remove rejected mock-ups from Authority property.

1.05 DELIVERY, STORAGE, AND HANDLING

Deliver signs in protective wrapping and store protected from weather, moisture and soiling. Coordinate on-site storage with the Engineer.

1.06 GUARANTEE

A. Contractor shall execute and submit a Guarantee, acceptable to the Engineer, that Work of this Section is in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of five (5) years from the date of issuance of the Certificate of Final Completion.

1. Guarantee shall cover, but not be limited to:
   a. Color fastness against fading or chalking.
   b. Non-yellowing of acrylic.
   c. Assembly, construction and operation.
   d. No noticeable cracking, chipping, peeling or delamination.
   e. Uniformity of light in sign illumination.
   f. Structural failure.

B. Contractor shall submit extended Warranties provided by suppliers of materials and finishes.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

See Appendix "B" for manufacturers list.

2.02 MATERIALS

The following materials shall be used, as applicable. Material gages and thicknesses shall be as shown on the Contract Drawings or, if not shown, as specified in this Section. Refer to 2.05 for Shop Finishing.

A. Structural Steel and Miscellaneous Steel Framing and Supports

Sizes and shapes shown on Contract Drawings.

B. Aluminum Sheet

Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish shown on the Contract Drawings, and with not less than the strength and durability properties specified in ASTM B 209 for alloy 6061-T6.

C. Aluminum Extrusions

Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish shown on the Contract Drawings, and with not less than the strength and durability properties specified in ASTM B 221 for alloy 6063-T5.

D. Steel Sheet

1. Commercial quality cold-rolled carbon steel sheet, stretcher leveled, complying with the following requirements as applicable:
   a. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, with Class C zinc coating; chemically treated in mill with phosphate solution and light chromate rinse.
   b. Uncoated Steel Sheet: ASTM A 1008, exposed, matte finish.
   c. Galvanized Steel Sheet: ASTM A 653, Coating Designation G 90, mill phosphatized.
2. Steel Sheet for Porcelain Enamel Panels: Special purpose "enameling iron or steel" of low metalloid and copper content, especially manufactured and processed for the production of porcelain enamel panels; ASTM A 424, commercial quality, Type II; thickness as required for structural performances, but not less than manufacturer's recommended minimums for profiles and applications shown on the Contract Drawings, and not less than 16 gage.

E. Aluminum Honeycomb Core for Porcelain Steel Panels

1-1/2 inch aluminum honeycomb with a foil thickness of 0.003 inch minimum, cell size 3/4 inch, and density of 1.8 lbs. per cubic foot.

F. Aluminum Backing Sheets for Porcelain Steel Panels

ASTM B 209; alloy, temper and finish as recommended by panel manufacturer. Sheet manufacturer's standard "stucco" embossed sheet finish. Thickness as required for structural performances, but not less than manufacturer's recommended minimums for profiles and applications shown on Contract Drawings, and not less than 18 gage for exterior panels.

G. Stainless Steel

Type 316L, plate, sheet or strip, complying with ASTM A 167.

H. Plastic Laminate

High-pressure laminate engraving stock with face and core plies in contrasting colors, scratch resistant, in thickness and color shown.

I. Cast Acrylic Sheet

Cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, ASTM D 4802, classification category A-1, smooth finish, UV absorbing, in sizes and thicknesses indicated on Contract Drawings, minimum flexural strength of 16,000 psi when tested in accordance with ASTM D 790, minimum allowable continuous service temperature of 176 degrees F (80 degrees C), unless otherwise noted.

1. At cutout acrylic lettering and graphics locations: Clear transparent and white translucent sheet of densities required to produce uniform brightness and minimum halation effects.
2. At silk screen graphics locations: White translucent sheet of density required to produce uniform brightness and minimum halation effects.
3. At color sheet graphics locations: Clear transparent facing sheet and white translucent backing sheet, same as sheets specified above for silk screen graphics locations.
4. Where "clear" sheet material is shown, furnish colorless sheet in matte finish.
5. Where "opaque" sheet material is shown, furnish colored opaque acrylic sheet in colors and finishes shown or, if not shown, as selected by the Engineer from the manufacturer's standards.

J. Colored Coatings for Cast Acrylic Sheet:

1. Where silk screen graphics are shown on the Contract Drawings: Colored coatings, including inks and paints for copy and background colors, shall be as recommended by acrylic manufacturers for optimum adherence to acrylic surface and non-fading for application shown on the Contract Drawings.
2. Where color sheet film graphics are shown on the Contract Drawings: Photographic sheet graphics placed between two cast acrylic sheets (specified above). Photographic sheet graphics shall be "Duratrans RA" display material, manufactured by Kodak, or approved equal. Finished sheet shall include a minimum 7.0 mil thick translucent base and shall be produced by using "Ektacolor RA" chemicals, manufactured by Kodak, or approved equal.

K. Polycarbonate Sheet

Clear, cast polycarbonate sheet with abrasion resisting coating both sides, in sizes, types and thicknesses shown on the Contract Drawings.

1. Strength: Minimum flexural strength of 13,500 psi when tested in accordance with ASTM D 790; Izod impact resistance of 16 lbf per inch when tested in accordance with ASTM D 256.
2. Service Temperature: Maximum allowable continuous service temperature of 240 degrees F.
3. Abrasion Resistance: Maximum 3 percent haze increase for 100 revolutions of a 500g Taber abraser when tested in accordance with ASTM D 1044.
4. Light Transmittance: Minimum 84 percent light transmittance for 1/4 inch thick clear sheet when tested in accordance with ASTM D 1003.

L. Vinyl Film

Computer generated electro-cut and die-cut vinyl, pressure-sensitive legends, 3M Company "Scotchcal" sheeting film, or approved equal. Execute die-cutting in such a manner that edges and corners of finished letterforms are true and clean. Letterforms with round positive or negative corners or with niched, cut or ragged edges are not acceptable.

1. Thickness: Maximum 0.003 inch.
2. Adhesive Quality: Minimum 55 oz. per inch width, after curing for 24 hours, required to break adhesive bond.
3. Cut in accordance with manufacturer's printed instructions.

M. Glazing Accessories

Setting blocks, spacers, compressible fillers and gaskets, setting points and other accessories required for the installation as recommended by the GANA's *Glazing Manual* and FGMA's *Sealant Manual*, for dry glazing system with compression gaskets. Gaskets shall be cellular, neoprene custom size and configuration as required, with pressure adhesive on one side. Neoprene filler rods, sealants and other accessories shall be as shown on Contract Drawings and as required for weather-tight and light-tight installations.

N. Fasteners

Same basic metal and alloy as fastened metal, unless otherwise shown on the Contract Drawings. Do not use metals that are corrosive or incompatible with metals joined.

1. Types, gages and lengths to suit installation conditions.
2. Concealed fasteners for interconnecting sheet metal fabrications and attachment to other construction.

O. Anchors and Inserts

Stainless steel or hot-dipped galvanized anchors and inserts as required for corrosion resistance, hidden when possible. Include inserts as required, to be set into substrate.

P. Mounting Tapes and Adhesives

Adhesives, as recommended by sign manufacturer, to suit installation conditions; "VHB" (Very High Bond) tape for mounting sign plaques, as manufactured by 3M Company, or approved equal.

Q. Mastic Sealant

Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

R. Gaskets

Tubular or fingered design of neoprene or polyvinyl chloride, or block design of sponge neoprene.

S. Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing minimum 94 percent zinc dust by weight, and complying with SSPC-Paint 20.

T. Bituminous Paint

Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

2.03 CONSTRUCTION FEATURES

Sign graphics and finish shall be as shown on the Contract Drawings.

A. Ceiling Mounted Signs

Fabricated of metal sheet and steel framing with copy on either one or two faces, as shown on the Contract Drawings.

B. Wall Mounted Signs and Plaques

Fabricated of metal sheet or plastic laminate and directly mounted to wall or fascia as shown on the Contract Drawings.

C. Pylon Signs

Square, triangular, rectangular shaped in plan, or as shown, in the form of either a tower or slab. Fabricated of metal sheet or aluminum sandwich panels and steel framing, as shown on the Contract Drawings.

D. Roadway Signs

Fabricated of metal sheet, aluminum sandwich panels and steel framing, as shown on the Contract Drawings.

E. Post and Panel Signs

Post mounted units fabricated of metal sheet and either aluminum or steel framing as shown on the Contract Drawings.

F. Suspended and Wall Mounted Signs

Fabricated of metal sheet or aluminum sandwich panels, and either directly mounted to a building fascia or façade or suspended by steel or aluminum framing, as shown on the Contract Drawings.

2.04 FABRICATION

A. General

Work shall be fabricated to details shown on the Contract Drawings and on the approved Shop Drawings, and shall be first class workmanship in accordance with the best trade practices. Cutting, fabrication and assembly shall be performed in the factory. Joints, corners, mitres and splices shall be accurately machined, filled, fitted and filed, rigidly framed together at joints and contact points, and painted smooth to give a monolithic appearance with imperceptible joints; there shall be no visible connections. Mechanical fasteners shall match color and finish of the sign where they occur. Exposed metal surfaces shall be smooth with unblemished finish. The completed sign shall be shipped to the job site as one complete unit.

1. Materials shall be selected for their surface flatness, smoothness and freedom from surface blemishes wherever exposed to view in the finished unit. Exposed-to-view surfaces that exhibit pitting, seam marks, roller marks, "oil canning", stains, discolorations or other imperfections on the finished unit are not acceptable.
2. Surfaces shall be covered with a protective cover non-deleterious to finish for protection until final installation or erection.
3. Field measurements shall be taken prior to preparation of Shop Drawings and fabrication.

4. Sandwich panels shall be made in lengths up to a maximum of 24 feet and shall be designed to be mounted horizontally. Locations of horizontal joints shall be determined by the layout of graphics on the signs in order to minimize graphics overlapping the joints. Minimum panel width shall be 2 feet and overall sign panel sizes shall be as shown on the Contract Drawings. Maximum span between supports on 1 inch panels shall not exceed 9 feet.

5. Porcelain steel panel units shall be formed in shape and size in accordance with approved Shop Drawings with allowable tolerances of plus or minus 1/16 inch.

6. Where aluminum is fastened to steel or other dissimilar metal, or where aluminum is in contact with concrete or masonry, contact surface shall be given a heavy coating of bituminous paint.

7. Form closures and trim members to profiles shown using the gage sheet metal shown. Furnish components required for support and installation of closures and trim. Fabricate closures and trim to tightly close with adjoining Work. Finish exposed edges of trim and closure strips. Joints in exposed Work shall not vary more than 1/32 inch in either width or alignment.

8. Locate fasteners to be concealed wherever possible, otherwise to be as inconspicuous as possible. Size fasteners to securely support the Work, and space to prevent buckling or waviness of the finished surface. Exposed fasteners shall be countersunk and filled to match finish.

9. Drill and tap holes required for securing closures to other surfaces. Fasteners shall be hidden from view or countersunk flush to surface.

10. Joints shall have contiguous concealed support to hold meeting faces in flush alignment. Miter or cope trim members at corners to form tight joints.

B. Welding, Brazing and Soldering

Comply with AWS D1.1 and D1.2 and NAAMM for recommended procedures in welding, brazing and soldering. Use filler metals that blend with and match the color of sheet metal being used and the required exposed finish appearance of the metals. Continuously weld, braze or solder corners and seams, and grind smooth and flush on exposed surfaces. Discoloration or stains between base metal and filler metal are not acceptable for exposed portions of natural metal finish.

1. Clean, pretin, heat, flux and sweat solder through full contact area of surfaces to be joined, in accordance with best standards of practice. Remove flux residue and foreign matter after soldering. Rinse soldered areas with water and wipe clean.

C. Graphics

1. The standard for sign messages shall be as shown on the Contract Drawings. Produce "camera-ready" artwork as required based on design furnished by the Engineer on a Macintosh compatible computer disk produced using Adobe Illustrator and QuarkXPress software.

2. Messages

a. Letterforms, numbers and symbols for silk-screens or die-cuts shall be prepared from photographic reproductions of repro-proofs of type set copy or computer-generated sign layouts. Film positives shall be submitted to the Engineer for approval, prior to preparation of silk-screens or vinyl lettering.

b. Silk-screen printing or vinyl die-cutting shall be executed in a such a manner that edges and corners of finished letterforms are sharp, true and clean. Copy with rounded positive or negative corners, edges built-up, bleeding or spattering, shall not be acceptable. Prepare each silk-screen in one continuous piece to accommodate total message coverage, unbroken horizontally or vertically.

c. Silk-screens and film positives shall be turned over to the Engineer. Refer to Appendix "A".

d. Silk-screen messages and symbols shall be per Contract Drawings and "camera-ready" artwork. Paint or ink shall be of the finest quality of heat, moisture and fadeproof pigments and vehicles.

e. Paint or ink shall be of type specially formulated and manufactured for application on the surface material upon which it is to be applied and recommended for such use by the manufacturer of the paint or ink. Priming, surface preparation and application of materials shall be in strict accordance with the manufacturer's written product data and description and as otherwise necessary to produce a finish free of blistering, bleeding, fading and other imperfections. Paint shall be ordered or mixed in quantity to assure consistent application for signs. Finishes shall be as approved by the Engineer during Shop Drawing review.

(1) Inks shall be products manufactured by Naz-Dar/KC, 3M Company, or approved equal that are specifically suited for applications shown on the Contract Drawings.

D. Internally Illuminated Signs

1. Internal housings and baffles shall be of aluminum sheets or bent plates in gages and thickness as shown on the Contract Drawings or, if not shown, as required by this Section.

2. Lamping and box design shall be such that even, consistant illumination is achieved across the sign face from edge to edge. Hot or cold spots, shadows or ghosting are not acceptable.

3. Graphics display shall use one of the following methods as shown on Contract Drawings:

a. Silk screen graphics or color sheet graphics as specified in this Section.

b. Cutout Copy:

Machine-cut letters, numbers, symbols and other graphic devices through the sign panel to produce precisely formed copy. Use high-speed cutters mechanically linked to master templates in a pantographic system, or equivalent process capable of producing characters of the style shown on the Contract Drawings with sharply formed edges.

(1) Backup

0.125 inch thick acrylic sheet backup attached to backside of the panel.

(2) Pushed-Through Graphics

Precise-fitting copy cut from 0.250 inch thick transparent acrylic sheet projecting through engraved copy, chemically welded to 0.125 inch thick acrylic sheet backup, where pushed-through graphics are shown on the Contract Drawings. Apply vinyl films where shown on the Contract Drawings.

4. Wiring within the sign shall be installed in accordance with the National Electrical Code and shall be neatly arranged and supported.
5. Ballasts shall be individually fused in an approved manner.
6. Wire terminals, taps and other electrical connectors shall be of an approved swaged, clinched or positive clamping type. Plain soldered lugs with no means of mechanically holding the wire without solder are not permitted.
7. Lamps, ballasts and fuses shall be arranged so that they are readily accessible for maintenance. Lamps and ballasts shall comply with the requirements of Division 16 Section on Lighting Systems. Determine actual types, lengths and wattages required for individual and fully legible signs. Furnish suitable lamps for interior and exterior use as required for even illumination of messages.
8. Illuminated signs shall be connected into the existing building circuitry. Install conductors from the existing junction boxes or relays to the service entrances in the signs in order to provide power to the lamps. The exact location of existing junction boxes or relays shall be determined in the field before making provisions for concealed service entrances in the signs. Make electrical fixture and power connections.
9. Illuminated signs shall be furnished with vent holes protected with insect screening, and adequately lightproofed.
10. Illuminated signs shall be of weather-tight construction.
11. Furnish prop bar for ease in relamping.
12. Furnish a photocell-operated switch in an inconspicuous location, for the individual operation of each sign for maintenance purposes.

E. Lighting Fixtures for Externally Illuminated Roadway Signs

1. Sign lighting fixtures shall be of the type specified hereinafter and shall be complete with self-contained ballasts, wired for operation and mounted and supported as shown on the Contract Drawings.
2. Fixtures shall be dust-tight, weather-tight and suitable for outdoor use. Ballasts shall be of the high power factor type and shall bear the stamp of approval of the Electrical Testing Laboratory. Ballasts and lamps shall be suitable for operation at temperatures down to minus 20 degrees F. Ballasts shall be fused with the proper size fuse as recommended by the manufacturer. The fuse holders shall be type HLR and be equipped with type GMF glass tube fuses as manufactured by Bussman Manufacturing Company, or approved equal.
3. Fixture housings shall be constructed of 18 gage (0.040 inch) aluminum, ASTM B 209, alloy 3003-H14, welded construction.
4. Exterior surfaces of fixtures shall be field painted or shall receive a factory-applied finish as shown on the Contract Drawings.
5. Fixture reflectors shall be minimum 0.020 inch thick aluminum, specular Alzak processed finish and of paracylindrical form.
6. Housing door for internal access shall consist of an enclosure lens of clear, unribbed acrylic plastic, 1/8 inch thick, and an enclosure frame of extruded aluminum, with vinyl or neoprene gasketing. This framed plastic door shall be connected to the fixture body by a continuous extruded hinged frame member. Extruded hinge shall be constructed to form a stop so that when the door is in the upward position it is past 90 degrees. Furnish a positive latch assembly to keep the cover in the open position and to prevent accidental release.

7. Door shall be secured in place against a polyvinyl gasket around the opening and secured with toggle action stainless steel catches.
8. Lamp sockets shall be protected by a polychloroprene moisture-proof boot.
9. Fixture shall have a barrier type terminal block for terminating the lamp socket wires.
10. Wiring shall be minimum number 10 AWG and as specified in Division 16 Section on Wires, Cables, Splices, Terminations.
11. Conduit shall be watertight and as specified in Division 16 Section on Raceways.
12. Signs shall be completely factory wired with at least five feet of slack to handholes at base of support for connection to branch circuits as shown on the Contract Drawings.

F. Plastic Laminate Sign Panels

1. Face Material

   High pressure plastic laminate engraving stock in finishes and color combinations shown on the Contract Drawings or, if not shown, as selected by the Engineer from the manufacturer's standard colors.

2. Back-Up Material

   Cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet in sizes and thickness shown on the Contract Drawings.

G. Plastic Laminate Plaques and Room Identification Signs

1. Unframed panel signs fabricated as follows, unless otherwise shown on the Contract Drawings:
   a. Edges: Square cut with edge color same as the background.
   b. Corners: Square.
2. Graphic Image

   Sign copy shall comply with the requirements for size, style, spacing, content and symbols shown on the Contract Drawings.

3. Machine-engrave letters, numbers and symbols into sign face to expose the contrasting core ply.

H. Sandwich Panel Signs

1. Perimeter Frames: Extruded aluminum alloy 6063-T6, heliarc welded.
2. Panel Thickness: 1 inch, unless otherwise shown on the Contract Drawings.
3. Finish: As specified in this Section or as shown on the Contract Drawings.
4. Aluminum honeycomb laminate construction: Minimum tensile strength of 50 psi in accordance with ASTM C 297 and ASTM C 481.
5. Adhesives: Thermosetting epoxy type. Bonding shall be done in a heated flat platten press of sufficient size to contain the entire panel at one time with 10 psi over the entire platten area.
6. Adhesively bonded panels shall have exterior faces of such flatness when measured at normal room temperature of 70 degrees to 80 degrees F that the maximum slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1.5 percent. Wave slope shall be computed by measuring the distance between high points and placing a straight edge across these points to determine the depth of slope. Flatness of signs shall be within a slope determination of 1 percent when checked in this manner.

7. For exterior signs, 1/8 inch diameter weep holes shall be drilled in the cap and the perimeter frame at the bottom of each panel 3 inches in from either end, and in the center of each panel.

I. Aluminum Sheet on Plywood Signs

Form sign panels of aluminum sheet, adhesively attached to fire-retardant plywood backing, as shown on the Contract Drawings.

2.05 SHOP FINISHING

A. General

1. Shop finish of signs shall be as follows and as shown on the Contract Drawings:
   a. Porcelain Enamel finish on Sandwich Panel signs, Aluminum Sheet on Plywood signs, or other type of sign face as shown on the Contract Drawings.
   b. Fluoropolymer 3-Coat System on aluminum.
   c. Clear or Color Anodic on aluminum.
   d. Acrylic Polyurethane on aluminum.
   e. Baked Enamel on steel or galvanized steel.
   f. Paint on steel or galvanized steel.
   g. Stainless Steel: Finish as shown on the Contract Drawings.
2. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for finish description and application recommendations, except as otherwise shown and specified.
3. Materials comprising a sign shall be finished with a coating system compatible with that material; priming shall be done in accordance with finisher's specification. Exposed surfaces, edges and connections shall receive this same finish system.

B. Surface Preparation

1. Aluminum: AA-C12-C42-R1x (Chemical Finish: Cleaned with inhibited chemical conversion coating; acid chromate-fluoride-phosphate pretreatment); coating system as specified below.
2. Steel for Porcelain Enamel Finish: Panels shall be thoroughly cleaned, degreased, acid etched, and neutralized.
3. Stainless Steel: The cleaned stainless steel surface shall be pretreated with a wash-coat conforming to Military Specification DOD-P-15328D or approved equal.
4. Before finishing, remove loose mill scale, dirt, weld flux, weld spatter and other foreign material.

C. Color

1. Exposed sign surfaces, including panel backgrounds, shall be in a color and gloss as shown on Contract Drawings or, if not shown, as selected by the Engineer from manufacturer's custom range.
2. Messages on sign panels to be satin or matte finish white, unless otherwise shown on Contract Drawings.
3. Exposed conduit, electrical boxes, clamps and connectors shall be painted to match sign finish.
4. Interior housing surfaces of internally illuminated signs shall be painted in a high-gloss white enamel finish.

5. Colors and degree of gloss for surface paint and finish applications shall be consistent throughout, regardless of substrate.

D. Porcelain Enamel Finish

1. General

a. Weather Resistance: The porcelain enamel finish on surfaces exposed to weathering shall pass the acid spot test in accordance with ASTM C 283. In addition, red, yellow and orange porcelain enamels shall pass the cupric sulfate test in accordance with ASTM C 538.

b. Continuity of Coating: Visual inspection of each piece shall reveal no visible breaks or surface defects in the cover coating that expose the underlying coating or the steel on surfaces exposed to weathering, nor the underlying steel on either the back or flanges. This requirement shall not apply to sheared edges.

c. Surface Appearance: The porcelain enamel on surfaces exposed to weathering shall be free of blemishes in the coating that may impair its serviceability or detract from the general appearance of the panel when viewed from a 5 foot distance.

2. Compliance Statement

Obtain from Manufacturer certification that the porcelain enameling is performed in accordance with PEI 1001.

E. Porcelain Enamel on Aluminum

1. Application: By automatic spray equipment and in conformance with PEI specifications; ASTM C 346 gloss reading of 50 to 70 units at an angle of 45 degrees when measured on the Photovolt meter.

2. Weight loss of porcelain enamel shall be less than 20 mg per square inch when tested in accordance with ASTM C 283.

3. Sign Graphics

a. Applied graphics shall be 0.080 inch thick flat sheet aluminum with a lamination of heat sensitive reflective sheeting, unless otherwise shown on the Contract Drawings to have integral colors.

b. Affix graphics to the sign panel with tape.

c. This method shall be used on other sign types and finishes, where shown on the Contract Drawings.

F. Porcelain Enamel on Steel

1. Application: Apply porcelain enamel by spray application. Panels are to be given a ground coat of porcelain enamel on all surfaces. Panel surfaces exposed to the weather shall be given a cover coat of porcelain enamel necessary to produce the required colors specified. Back and other concealed areas of the panel shall be given at least one coat of porcelain enamel (in addition to the ground coat) for protection and as an aid to maintain shape during firing. Ground and cover coats of porcelain enamel on the front or exposed surface of the panel shall be a minimum of 8.5 mils. Minimum thickness of ground coat shall be 2.5 mils.

a. Fire panels at approximately 1450 degrees F in a continuous furnace to properly fuse the porcelain enamel to the metal and ensure color uniformity.

b. Check colors and gloss of the porcelain enamel finish during each production run. Produce colors and gloss finishes within the limits established by porcelain samples approved by the Engineer.

G. Fluoropolymer 3-Coat System

Manufacturer's standard 3-coat thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene resin by weight (Atofina "Kynar 500", or Solvay Solexis, Inc. "Hylar 5000"), complying with AAMA 2605; color and gloss as shown on the Contract Drawings or, if not shown, as selected by the Engineer from manufacturer's custom range.

H. Anodic Finishes

Finish designations prefixed by "AA" shall conform to the system established by the Aluminum Association for designating aluminum finishes, listed in NAAMM's *Metal Finishes Manual for Architectural and Metal Products.*

1. Class I Clear Anodic Finish

   AA-M12-C22-A41 (nonspecular as fabricated; medium matte etched surface; Architectural Class I clear coating 0.7 mil or thicker), complying with AAMA 611.

2. Class I Color Anodic Finish

   AA-M12-C22-A42/A44 (nonspecular as fabricated, medium matte etched surface, Architectural Class I, integrally color or electrolytically deposited color coating 0.7 mil or thicker), complying with AAMA 611.

3. Apply protective coating of clear acrylic lacquer of not less than 0.05 mil, dry film thickness.

I. Acrylic Polyurethane on Aluminum

1. As manufactured by Matthews Paint Company, 8201 100th St., Pleasant Prairie, WI, or approved equal.

   a. Colors must be proven to be equal in color and gloss retention to corresponding colors of Matthews Acrylic Polyurethane by United States Testing Company, Inc., Chemical Service Div., 1415 Park Avenue, Hoboken, NJ. The laboratory test shall consist of 1,000 hours in a QUV accelerated weathering tester maintained in accordance with ASTM G 154. The tester shall be programmed to alternate 40 degrees Celsius water condensation 4-hour periods with 60 degrees Celsius ultraviolet 4-hour periods. Gloss measurements are to be made with a Hunterlab color difference meter (ASTM D 523 and D 2244, respectively).

   b. Proposed alternate coating systems shall include comparative results as indicated above from United States Testing Company, Inc., or other equivalent testing lab acceptable to the Engineer.

2. Acrylic polyurethane system shall be ultraviolet inhibited, lead and heavy metal free.

3. Surface to be coated shall be prepared, primed and finish coated in accordance with coating manufacturer's instructions.

4. Paint shall be thoroughly and evenly applied and shall be well worked into corners and joints and shall have no edge or joint build-up.

5. Coating shall be applied at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness of not less than 4.0 mils for the entire coating system of prime/conversion coating and finish coats for 2-coat work.

J. Baked Enamel Finish on Steel or Galvanized Steel

Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish, consisting of prime coat and minimum 1.0 mil dry film thickness thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve total minimum dry film thickness of 2.0 mils; color and gloss shall be as shown on the Contract Drawings.

K. Paint Finish on Steel Sheet

1. Surface Preparation

Solvent-clean surfaces in compliance with SSPC-SP 1 to remove dirt, oil, grease and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel in compliance with SSPC-SP 5 or SSPC-SP 8.

2. Factory-Priming for Factory Painted Finish

Apply shop primer, specified in Division 9 Section on Painting, immediately following surface preparation and pretreatment.

L. Paint Finish on Galvanized Steel Sheet

1. Surface Preparation

Clean surfaces of dirt, grease and other contaminants. Follow by a conversion coating of type suitable for organic coating application. Clean welds, mechanical connections and abraded areas. Follow by SSPC-Paint 20 galvanizing repair paint applied in accordance with ASTM A 780.

2. Factory-Priming for Field Painted Finish

Where field painting after installation is specified or shown on the Contract Drawings, apply air-dried primer, specified in Division 9 Section on Painting immediately following cleaning and pretreatment.

M. Stainless Steel Finish

Furnish one or more of the following finishes, where shown on the Contract Drawings:

1. Bright, Directional Polish: AISI No. 4 finish.
2. Satin, Directional Polish: AISI No. 6 finish.
3. Satin, Reflective, Directional Polish: AISI No. 7 finish.
4. Mirror-Like Reflective, Non-Directional Polish: AISI No. 8 finish.
5. Non-Directional Finish: As specified in Division 5 Section on Stainless Steel Finish.

PART 3. EXECUTION

3.01 EXAMINATION

Examine substrates and conditions under which Work is to be installed before sign components are delivered to the site. Report in writing to the Engineer conditions that will prevent proper execution of the Work or endanger its permanency. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer. Commencement of the Work shall constitute acceptance of the conditions.

3.02 PREPARATION

A. Determine location of utilities that will be within the excavation site. Immediately notify the Engineer of conflicting conditions.

B. Schedule installation of signs at the convenience of the Engineer, so that the Work may be coordinated with other finishing in progress within the building. Signs shall be erected by skilled workmen especially trained in this type of work.

3.03 INSTALLATION

A. Install signs, including sign structures, anchorages, electrical components and required connections into existing circuits.

B. Comply with manufacturer's product data and published instructions for material installation requirements.

C. Install the Work in location, in alignment and in elevation, free of rack, plumb, level and straight with no distortions, measured from established lines and levels. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8 feet for plumb and level, with maximum 1/32 inch offset in flush adjoining sign panels, and maximum 1/16 inch offsets in flush and in revealed adjoining surfaces. Level with instruments; measuring equal distances from existing building surfaces is not acceptable as a basis of level and plumb.

D. Execute drilling, cutting and fitting carefully and fit at job before finishing. Install anchors, expansion bolts and anchor bolts for complete anchorage. Install supporting members, fastenings, framing, bracing brackets, straps, bolts and angles as required to set and connect signage Work rigidly and properly to underlying construction.

E. Obtain prior approval of Engineer before field cutting or drilling galvanized steel.

F. Set anchor bolts and anchorages with templates to correct elevations, plumb and true, where shown on the Contract Drawings; complying with approved Shop Drawings. Complete connections in proper alignment and tighten bolts securely.

G. Sign faces shall be flat, true and free from oil canning and waviness; exposed surfaces shall not deviate from flat by more than 1/16 inch in any 36 inch distance.

H. Bases and Pedestals

Coordinate setting with Contract Drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the construction site.

I. Sign Posts and Supports

1. Locate field splices in the sign structures where shown on the Contract Drawings.
2. Form weather-tight joints with connections.
3. Connections shall not be visible, unless otherwise shown.
4. Install concealed gaskets, flashing, sealants, fillers and insulation per manufacturer's recommendations as the Work progresses, to make the installations sealed.

5. Repair finishes damaged by cutting, welding, soldering and grinding operations required for shop fitting and jointing. Restore finishes and paint so that there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make the new required alterations, and refinish the entire unit or furnish and install new units at fabricator's option.

6. Fasteners

   a. Fasteners shall be concealed, except where otherwise noted on Contract Drawings. Exposed fasteners, if any, shall be flush and match color and finish of adjacent surfaces.

   b. When dissimilar metals are in contact, coat and finish the contacting surfaces compatibly to their adjacent surfaces.

   c. Visible welding shall be continuous, ground smooth and finished; seams shall be made invisible. Internal welding shall be structurally sound and eliminate racking.

J. Touch-Up

1. Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint, and paint exposed areas with same paint used for shop painting. Field apply by brush or spray to yield a minimum dry thickness of 2.0 mils.

2. Touch-up abraded galvanized surfaces with galvanized repair paint applied in accordance with ASTM A 780.

3.04 FIELD TESTS

Test and adjust illuminated electrical signs for illumination level, hot spots and light leaks.

3.05 CLEANING

A. Upon completion of Work, remove tools, equipment, surplus and discarded materials from the site, including debris, dirt and rubbish accumulated as a result of the sign installation. Leave the site in a neat and presentable condition.

B. Clean site of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits.

C. Upon completion of final installation, clean surfaces of units of work to normal "clean" condition. Comply with manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove temporary protective coverings and labels that are not required as permanent labels.

2. Clean exposed hand-surface finishes to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Avoid disturbance of natural weathering of surfaces, except as otherwise indicated. Restore reflective surfaces to original reflective condition.

3. Wipe surfaces of mechanical and electrical equipment clean; remove excess lubrication and other substances.

4. Clean light fixture housings and lamps to permit functioning with full efficiency.

END OF SECTION

SECTION 10430

ARCHITECTURAL SIGNAGE SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

10430A01 Mark Shop Drawings and samples to show name and address of project, Engineer, Contractor, manufacturer and supplier.

10430A02 Identify the locations where materials or equipment are to be installed. Show the various parts of the sign construction, including: fastenings, anchorage, lighting, details of lighting fixture supports, electrical fixtures and connections, wiring, stiffening, bracing, types and thicknesses of metal, finishes and complete instructions regarding concealed joints, welds and adjacent and related Work.

10430A03 Submit erection drawings for the complete installation of the signs.

Samples

10430C01 Submit samples of each sign type to demonstrate quality of fabrication methods, material finishes and color. Matching shall be subject to approval by the Engineer.

10430C02 Submit samples of required finish materials and graphics processes for signage.

10430C03 Color match Engineer's samples for sign support coating and for sign panel paint or finish system. Submit color chips on samples of actual materials in each color required by project to be used for sign construction, including light fixture finishes. Minimum sample size is 12 by 12 inches.

10430C04 Vinyl lettering and graphics shall include at least one uppercase and one lowercase letter of each lettering style and one of each type of graphics shown on the Contract Drawings. Submit actual full size letterforms and graphics of each size to be used, mounted on samples of actual materials to be used for Work of this Section.

10430C05 Submit actual full-scale silk-screen letterforms of each size and style of letters shown on Contract Drawings to be used, mounted on samples of actual materials to be used for sign construction.

10430C06 Stencil-cut aluminum with pushed-through acrylic for fabrication of illuminated signs, including accessory materials. Submit samples for both pylon type sign and existing sign band locations. Supply one uppercase and one lowercase letter form for each lettering style shown on the Contract Drawings.

10430C07 Porcelain enamel sign panels, including lettering and graphics. Include at least one uppercase and one lowercase letter of each lettering style shown on the Contract Drawings.

10430C08 Exposed trim, connections and closures. Submit color and material samples of actual materials to be used.

10430C09 Each sample submittal shall have a typed label showing: Name of project.
1. Address of project.
2. Contractor's name.
3. Name and description of item represented.

10430C10 Sign Panel Materials and Sign Graphics: Furnish one 6 inch by 6 inch sample of each different sign panel material and finish type and of each graphic material type with sample letter used in the Work of this Section. Mark each sample with typed label per C.9 above. Deliver samples to the Engineer. Samples shall become the property of the Authority.

10430C11 Silk-Screens and Film Positives: Deliver to the Engineer in good, usable condition to become the property of the Authority. Number in accordance with the Type Nomenclature.

Product Data

10430D01 Submit manufacturer's literature and descriptive data including catalog sheets for materials, instructions for cleaning, equipment and fixtures showing control, schedule and other pertinent information as required. Where printed materials describe more than one product or model, clearly identify which is submitted for approval.

10430D02 Submit data for fire-retardant treatment type for plywood, if any.

Calculations

10430H01 Submit design calculations for sign panels and structural supports.

Manuals, Warrantees/Guarantees

10430I01 Sample of guarantee for materials and workmanship.

10430I02 Sample of material and finish extended warranties.

Qualifications

10430K01 For entities specified in this Section (professional engineer, fabricator and installer), demonstrating their capabilities and experience. Include list of completed projects with project names, addresses, names of architects, owners and other information specified.

END OF APPENDIX "A"

SECTION 10430

ARCHITECTURAL SIGNAGE SYSTEMS

APPENDIX "B"

MANUFACTURERS

A. Subject to compliance with the requirements of this Section, furnish and install products by the following, or approved equal:

ABC Architectural Signing System, Div. of Nelson Harkins Ind., Chicago, IL

Andco Industries Corp., Greensboro, NC

Artisan Graphic Group, Huntington Station, NY

ASI Sign Systems, Inc., New York, NY

Going Sign Co., Inc., Plainview, NY

Lolite International, West Columbia, SC

Signal Sign Co., Livingston, NJ

Signs + Decal Corp., Brooklyn, NY

Spectrum Signs Inc., Farmingdale, NY

Wilcox Brothers Sign & Awning Co., Tonawanda, NY

B. Subject to compliance with the requirements of this Section, furnish and install porcelain sign products by one of the following, or approved equal:

American Porcelain Enamel Co., Dallas, TX

Cherokee Porcelain Enamel Co., Knoxville, TN

Enameltec, Div. of P.G. Bell, Georgetown, Ontairo, CN

END OF APPENDIX "B"

DIVISION 10

SECTION 10810

TOILET ACCESSORIES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for toilet accessories, including mirrors.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

American Society for Testing and Materials (ASTM)

ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A 666	Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
ASTM A 1008	Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B 16	Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
ASTM B 19	Specification for Cartridge Brass Sheet, Strip, Plate, Bar and Disks.
ASTM B 30	Specification for Copper Alloys in Ingot Form.
ASTM B 456	Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
ASTM C 1503	Specification for Silvered Flat Glass Mirror.
ASTM F 446	Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility

Furnish products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise approved by the Engineer.

B. Electrical Components, Devices and Accessories

Listed and labeled as defined in NFPA 70, Article 100, by an approved listing and testing agency, and marked for intended use.

1.04 WARRANTY

A. Mirrors

Where mirrors are to be furnished and installed, furnish manufacturer's written warranty against silver spoilage of mirrors, whereby manufacturer agrees to replace mirrors that develop visible defects within warranty period. Warranty period for mirrors shall be fifteen (15) years after the date of issuance of the Certificate of Final Completion, shall run to the benefit of the Authority and shall grant the Authority a direct right of action against the manufacturer.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements specified in this Section, furnish and install products of one of the following, or approved equal:

A & J Washroom Accessories, New Windsor, NY
American Specialties, Inc., Yonkers, NY
Bobrick Washroom Equipment, Inc., North Hollywood, CA
Bradley Corporation, Menomonee Falls, WI

2.02 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin) for exposed surfaces, unless otherwise specified or shown on the Contract Drawings.

B. Brass: ASTM B 19, flat products; ASTM B 16, rods, shapes, forgings and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: Cold-rolled, commercial quality, ASTM A 1008, 0.0375 inch (20 gage) minimum thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653, G60 hot-dip zinc coating.

E. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

F. Chrome Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Service Condition No. SC 2 (moderate service).

G. Mirrors: ASTM C 1503, with Mirror Select Quality, clear glass mirrors, nominal 1/4-inch (6 mm) thick.

H. Stainless Steel Mirror Surfaces: Type 304 stainless steel sheet, or Type 430 as specified, stretcher-leveled with No. 8 polished mirror finish, 0.0375 inch (20 gage) minimum thickness, bonded to minimum 1/4-inch thick hardboard backing.

I. Fasteners: Screws, bolts and other devices of same material as accessory unit, tamper and theft resistant where exposed, and of galvanized steel where concealed.

2.03 CONSTRUCTION FEATURES

A. General

Furnish toilet accessories as shown on the Contract Drawings, in sizes, dimensions, capacities, equipment, material, color and finish as specified herein, unless otherwise shown on the Contract Drawings.

B. Keys

Furnish universal keys for access to toilet accessory units requiring internal access for servicing and resupplying. Furnish minimum of six keys to the Engineer.

C. Toilet Tissue Dispensers

1. Roll-In-Reserve

Stainless steel, for mounting indicated below, sized to store and dispense either 4-1/2-inch diameter or 5-inch diameter core tissue rolls, with reserve roll placed in service by automatic release or by action of manual release bar. Hinge front of unit with pivot hinge and secure with tumbler lockset.

a. Furnish mounting type of one or more of the following, where shown on the Contract Drawings: Partition-mounted, designed to service two adjacent toilet compartments, two rolls for each; surface-mounted, with concealed anchorage; or semi-recessed for nominal 4-inch wall depth.

2. Jumbo-Roll, Surface-Mounted

Stainless steel cabinet, door and mounting plate, with viewing slot for tissue level. Swing-down door shall be equipped with tumbler lockset.

a. Furnish one-roll unit dispensing one roll up to 10-inch diameter, or two-roll unit dispensing up to two rolls up to 10-inch diameter with sliding panel to expose other roll, as shown on the Contract Drawings.

D. Seat-Cover Dispensers

1. Surface-Mounted Type

Stainless steel with concealed opening at bottom for filling; capacity not less than 250 seat covers.

2. Partition-Mounted, Dual-Access Type

Stainless steel, with fixed and adjustable 1-inch wide seamless wall flanges to install in cutout in toilet partition, to serve two compartments. Furnish hinged access door with tumbler lock for servicing from one side.

3. Recessed Type

Stainless steel for nominal 4-inch wall depth. Furnish seamless 1-inch wide wall flange and hinged front with tumbler lockset; capacity not less than 500 seat covers.

E. Paper Towel Dispensers

1. Recessed

Stainless steel, for nominal 4 inch wall depth, sized to dispense not less than 400 C-fold or 525 multi-fold paper towels unless otherwise shown on the Contract Drawings, without use of special adaptors. Door shall be equipped with tumbler lockset.

2. Surface-Mounted

Stainless steel with hinged front with pierced slots at sides as refill indicator, sized to dispense not less than 400 C-fold or 525 multi-fold paper towels unless otherwise shown on the Contract Drawings, without use of special adaptors. Door shall be equipped with tumbler lockset.

F. Waste Receptacles

1. Open-Top, Recessed

Stainless steel with seamless exposed flange, removable receptacle with seamless exposed walls, hemmed edges, secured by tumbler lockset. Furnish heavy-duty vinyl removable liner, secured to receptacle at not less than 4 points by means of grommets, stainless steel hooks; minimum 10.5 gallon capacity.

2. Closed-Top, Recessed

Stainless steel with seamless full panel reinforced door equipped with tumbler lockset and push-in, self-closing top door. Furnish removable waste container of rigid molded plastic; minimum 10.5 gallon capacity.

3. Surface-Mounted

Stainless steel with seamless exposed walls and continuously welded bottom pan. Furnish heavy-duty vinyl removable liner, secured to receptacle at not less than 4 points by means of grommets, stainless steel hooks; minimum 20 gallon capacity.

4. Surface Wall-Mounted Corner

Stainless steel with seamless exposed walls and continuously welded bottom pan. Furnish heavy-duty removable vinyl liner, secured to receptacle at not less than 3 points by means of stainless steel grommets and hooks; minimum 13 gallon capacity.

5. Free-Standing

Stainless steel with swing top and heavy-duty reusable vinyl liner; minimum 21 gallon capacity.

6. Under-Counter

Unit designed for mounting under countertop, fabricated of stainless steel with seamless exposed faces, continuously welded bottom pan, and with self-closing disposal door. Furnish reusable, heavy-duty vinyl liner; minimum 5 gallon capacity.

G. Combination Towel Dispenser/Waste Receptacle Units

1. Recessed Unit

Stainless steel combination unit fabricated for nominal 4-inch wall depth and with continuous seamless wall flange. Towel compartment in upper portion of unit designed to dispense not less than 400 C-fold or 700 multi-fold paper towels. Waste receptacle in lower portion of unit furnished with reusable heavy-duty vinyl liner; minimum 12 gallon capacity. Furnish flush doors with piano hinges and tumbler locks on upper and lower compartments.

2. Recessed Unit with Projecting Receptacle

Stainless steel combination unit fabricated for nominal 4-inch wall depth and with continuous seamless 1-inch wall flange. Furnish towel compartment in upper portion of unit, designed to dispense not less than 400 C-fold or 700 multi-fold paper towels. Double panel door with continuous piano hinge and tumbler lock. Waste receptacle in lower portion of unit furnished with reusable heavy-duty vinyl liner; minimum 12 gallon capacity, secured in place by tumbler lock.

H. Multi-Purpose Units

1. Type MP-1

Stainless steel combination soap/towel dispenser unit, designed for recess mounting behind continuous mirror or behind wall. Towel dispenser designed to dispense minimum 500 C-Fold or 800 multi-fold paper towels. Soap dispenser capacity 80 oz.; furnish with push-type soap valve designed to dispense soap in measured quantities in liquid or lather form.

I. Sanitary Napkin Dispensers

Stainless steel unit, all-welded seamless construction, with returned edges and equipped with tumbler lockset. Furnish identification reading "Napkins" and "Tampons" at coin slots; brand name advertising of products dispensed is not permitted. Capacity shall be not less than 30 napkins and 20 tampons.

1. Mounting

Fully recessed type for nominal 6-inch wall; or semi-recessed type, with stainless steel collar to extend unit from nominal 4-inch wall cavity; or surface-mounted type, as shown on the Contract Drawings.

2. Operation

Fifty-cent coin operation, with locked coin box keyed separately from door and other accessory units.

J. Sanitary Napkin Disposal Units

1. Partition-Mounted Dual-Access Type

Stainless steel, equipped with adjustable flanges to permit partition mounting to service two toilet compartments. Furnish with self-closing door and all-welded stainless steel receptacle removable from one side.

2. Surface-Mounted Type

Stainless steel with seamless exposed walls, tightly self-closing top cover and locking bottom panel with continuous stainless steel piano hinge.

3. Recessed Type

Stainless steel, fabricated for nominal 4-inch wall depth. Furnish self-closing door and removable stainless steel receptacle of all-welded construction.

K. Soap Dispensers

1. Liquid Soap Dispenser, Deck-Mounted

Deck-mounted piston and spout type unit with minimum 16 fl. oz. capacity polyethylene reservoir concealed below deck. Piston and spout shall be stainless steel with bright polished finish with chrome-plated brass deck escutcheon. Spout shall be 4 inches long. Equip unit with valve for dispensing soap in liquid form.

a. Furnish unit designed for mounting on vanity deck or lavatory deck of thickness shown, or as shown on the Contract Drawings.

2. Liquid Soap Dispenser, Horizontal Recessed Tank Type

Recess mounted in wall, stainless steel tank type dispenser; minimum 32 fl. oz. capacity. Furnish stainless steel piston, springs and internal parts designed to dispense soap in measured quantity by pump action, and with integral check valve to prevent leaking. Unit shall be removable for servicing by means of tumbler lock. Furnish stainless steel cover with unbreakable window-type refill sight gauge. Equip unit with push type valve for dispensing soap in liquid or lather form.

3. Liquid Soap Dispenser, Horizontal Surface Tank Type

Surface-mounted, stainless steel tank type dispenser; minimum 40 fl. oz. capacity. Furnish stainless steel piston, springs and internal parts designed to dispense soap in measured quantity by pump action. Unit shall be serviceable by means of locked filler top. Furnish stainless steel body with unbreakable window-type refill sight gauge. Equip unit with push type valve for dispensing soap in liquid or lather form.

L. Grab Bars

Stainless steel tube, 1-1/2 inch o.d. with minimum wall thickness of 0.050 inch (18 gage), in configuration as shown on the Contract Drawings, with 1-1/2 inch clearance between wall surface and inside face of bar. Concealed mounting shall be manufacturer's standard flanges and anchorages.

1. Gripping Surfaces

Smooth, satin finish at dry areas or manufacturer's standard non-slip texture at wet areas, or as shown on the Contract Drawings.

M. Fold-Down Purse Shelf

Surface-mounted, stainless steel fold-down shelf, 15 inches long by 5-1/2 inches wide, hinged unit spring-loaded to provide automatic return to vertical position after use.

N. Warm-Air Hand Dryer

Surface-mounted, cast iron base, with manufacturer's standard white porcelain enamel cover, with fixed position nozzle. Equip with electronic sensor activation and adjustable timed power cut-off switch. Set operation time for 30 seconds. Electrical requirements shall be as shown on the Contract Drawings.

O. Mirror Units

1. Standard Stainless Steel Framed Mirror Units

Fabricate frame with channel shapes in minimum 0.0375 inch (20 gage) stainless steel, with square corners carefully mitered to hairline joints and mechanically interlocked. Furnish in Type 430 bright polished finish.

2. Fixed-Tilt, Stainless Steel Framed Mirror Units

Stainless steel frame, minimum thickness 0.0375 inch (20 gage), with joints mitered, welded and ground smooth. Construct frame so that taper is not less than 3 inches from top to bottom.

3. Adjustable-Tilt, Stainless Steel Framed Mirror Units

Stainless steel frame of angle or channel shapes, minimum thickness 0.0375 inch (20 gage), with square corners carefully mitered to hairline joints, welded and ground smooth. Furnish continuous, stainless steel piano hinge at bottom of unit and adjustable elbow hinge at each side to allow pivoting from vertical to not less than 6 inches outward at top.

4. Frameless, Stainless Steel Security Mirror

Single piece mirror and integral frame of minimum 0.050 inch (18 gage) Type 430 stainless steel, polished to a No. 8 mirror (bright polished) finish. Furnish unit with factory-drilled holes for mounting with stainless steel tamperproof mounting screws. Nominal size shall be 11 inches wide by 17 inches high.

P. Shower Curtain Rod, Heavy-Duty

Stainless steel tube, 1-1/4 inch o.d. with minimum wall thickness of 0.050 inch (18 gage); furnish 3 inch o.d. minimum 0.0375 inch (20 gage) stainless steel flanges, designed for exposed fasteners.

Q. Anti-Bacterial Shower Curtain

10 oz. nylon-reinforced anti-bacterial vinyl fabric with hemmed edges. Fabric shall be flameproof, stain resistant and self-deodorizing, with corrosion resistant grommets on 6-inch centers through top hem. Furnish in surgical green color, unless otherwise shown on the Contract Drawings. Size shall be minimum 6 inches wider than opening by 72 inches high.

R. Shower Curtain Hooks

Stainless steel spring wire curtain hooks with snap fasteners, sized to accommodate curtain rod size specified above.

S. Recessed Soap Dish

One-piece construction of seamless stainless steel for recess mounting in wall. Furnish with mounting clamp or lugs appropriate for wall construction shown on the Contract Drawings.

T. Towel Bar

Stainless steel tubular bar, 3/4-inch square, with rectangular end brackets, 24 inches long. Furnish galvanized backplates for concealed wall mounting.

U. Mop and Broom Holder/Utility Shelf

Combination unit with minimum 0.050 inch (18 gage), stainless steel shelf with 1-1/2 inch returns and support brackets for wall mounting; and minimum 0.0625 inch (16 gage) stainless steel shelf front hooks for wiping rags, together with spring-loaded rubber cam type mop/broom holders, and 1/4 inch diameter stainless steel drying rod suspended beneath shelf. Furnish 36 inch long unit with four mop/broom holders and three hooks.

V. Mop and Broom Holder

"Hat" channel of minimum 0.0312 inch (22 gage) stainless steel, with spring-loaded rubber cam type mop/broom holders. Furnish 36-inch long unit with four holders.

2.04 FABRICATION

A. Product Identification: Only an unobtrusive stamped logo of manufacturer, as approved by the Engineer, is permitted on exposed face of units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a printed, waterproof label or a stamped nameplate, indicating as a minimum, manufacturer's name and product model number.

B. Construction: Fabricate units of all welded construction with tight seams and joints, with exposed edges rolled. Hang doors and access panels with full length, continuous stainless steel piano hinges. Furnish concealed anchorage wherever possible.

C. Mirror Units

1. Edge Protection

Fabricate frames for glass mirrors to accommodate wood, felt, plastic or other glass edge protection material.

2. Backing

Galvanized steel backing sheet, not less than 0.0312 inch (22 gage) and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.

3. Hangers

Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove, unless shown otherwise on the Contract Drawings.

4. Heavy-Duty Frame

Fabricate with angle shapes of minimum 0.050 inch (18 gage) stainless steel with square corners mitered; welded and ground smooth; Type 430 bright polished finish.

5. Shelves

Where shown on the Contract Drawings, fabricate from stainless steel in same gage and finish as mirror frame, approximately 5 inches deep by width of mirror. Turn down and return edges for additional rigidity, with welded, ground and polished corners. Weld shelves securely to bottom of mirror frame; furnish concealed rigid bracket supports for shelf widths exceeding 36 inches.

PART 3. EXECUTION

3.01 PREPARATION

A. Coordinate accessory locations with other Work to avoid interference and to assure proper operation and servicing of accessory units.

B. Furnish inserts and anchoring devices which must be set in concrete or built into masonry. Coordinate delivery with other Work to avoid delay.

3.02 INSTALLATION

A. Install toilet accessory units in accordance with manufacturer's instructions, using fasteners appropriate for substrate type and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights shown on the Contract Drawings or, if not shown, as recommended by the unit manufacturer.

B. Mirrors

Set units plumb, level and square at locations shown. Secure mirrors to walls in concealed tamperproof manner with special hangers, toggle bolts or screws as appropriate for type of substrate and in accordance with manufacturer's instructions.

C. Grab Bars

Install grab bars to withstand a minimum downward load of 250 lbs. when tested in compliance with ASTM F 446. Grab bars may not rotate within their holding device or fittings.

3.03 ADJUSTMENTS

A. Adjust accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish exposed surfaces after removing temporary labels and protective coatings.

C. Clean exposed surfaces of mirror units in compliance with manufacturer's recommendations.

END OF SECTION

SECTION 10810

TOILET ACCESSORIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

10810A01 *Setting drawings, templates, instructions, directions for installation of anchorage devices* and cut-out requirements in other work.

Product Data

10810D01 Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gauges, profiles, mounting method, specified options and finishes.

Manuals, Warrantees/Guarantees

10810I01 Maintenance instructions including replaceable parts and service recommendations.

10810I02 Prior to issuance of the Certificate of Final Completion, submit manufacturer's warranty for any mirrors provided to the Engineer.

Schedules

10810J01 Schedule indicating manufacturer, accessory type and model number, quantities, sizes, and installation location for each accessory shown on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 13

SECTION 13086

DISC BEARINGS

PART 1. GENERAL

1.01 SUMMARY

A. This Section and its appendices specify requirements for furnishing and installing high-load multi-rotational disc type bearings including distribution plates, distribution pads, connection hardware, grout pads, anchor bolts, restrainers, guide devices, headed welded studs, etc., as required for a complete installation in accordance with the Contract Drawings.

1.02 SYSTEM DESCRIPTION

A. Disc bearings shall consist of a polyether urethane structural element (disc) confined by upper and lower steel bearing plates. The bearing shall be equipped with a shear resisting mechanism, and/or positive location device to prevent lateral movement of the disc. Bearings shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

1. Guided/Expansion Disc Bearings. Each guided/expansion disc bearing shall consist of an upper and a lower unit. The lower unit consists of a masonry bearing plate and a polyether urethane disc confined between by upper and lower steel bearing plates. A shear restriction mechanism shall be provided to transfer lateral loads between the lower bearing plate and the upper bearing plate. A polytetrafluoroethylene (PTFE) sheet is bonded to the upper bearing plate. The upper unit consists of an embedded plate, a top sole plate, and a stainless steel sheet welded to the bottom side of the top sole plate. Guide bars shall be attached to the top sole plate. All interfaces between the guide bars of the upper unit and the upper bearing plate of the lower unit shall be provided with stainless steel sheet against PTFE. The stainless steel sheet shall be welded to the guide bars and the PTFE sheet shall be bonded to the upper bearing plate of the lower unit. For Uplift Bearings, guide bars with tie-down capacity to meet the uplift loads shall be provided as shown on the Contract Drawings. The shear restriction mechanism shall be designed to transfer the uplift loads from the upper bearing plate to the lower bearing plate.

2. Fixed Disc Bearings. Each fixed disc bearing shall consist of a masonry bearing plate, a lower and an upper bearing plate, with a polyether urethane disc between the lower and upper bearing plates, a sole plate and an embedded plate. A shear restriction mechanism shall be provided to transfer lateral loads between the lower bearing plate and the upper bearing plate. The upper bearing plate shall be attached to the sole plate.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM International)

ASTM *Standard Specification for*

A36	Carbon Structural Steel
A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A563	Carbon and Alloy Steel Nuts
A709	Structural Steel for Bridges
B833	Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) for the Corrosion Protection of Steel
D6386	Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
F436	Standard Specification for Hardened Steel Washers
F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
F1554	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
	American National Standards Institute
B 18.3	Special Purpose Fasteners, Inspection and Quality Assurance
	American Welding Society, Inc. (AWS)
D1.5	Bridge Welding Code
D1.6	Structural Welding Code—Stainless Steel
	American Association of State Highway and Transportation Officials (AASHTO)
2012 Edition	LRFD Bridge Design Specifications
2012 Edition	LRFD Bridge Construction Specifications
M 232	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
	Port Authority Standard Specifications
Section 05120	Structural Steel
Section 09910	Painting
	US Department of the Navy (NAVY)
QPL-AS8660 -2	Silicone Compound

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design the bearing assemblies based on the current AASHTO LRFD Bridge Design Specifications, including latest interims, and also based on the following:

1. The bearing assembly design requirements for vertical loads, lateral loads and movements as shown in the Contract Drawings.
2. The bearing assembly shall be removable and replaceable by raising the bridge superstructure 3/8 inch maximum. The bearing shall be held in place by recessing the upper and lower bearing plates into the sole and masonry plate as shown on the Contract Drawings.
3. The area of the polyether urethane disc shall be designed for an unfactored stress of 5,000 psi ± 5 percent at full dead load and live load.

4. The area of the PTFE surface shall be designed such that the contact pressure does not exceed the maximum contact pressure specified in Table 14.7.2.4-1 of the AASHTO LRFD Bridge Design Specifications. The contact stress shall be determined at the service limit state as specified in Section 14.7.2.4 of the AASHTO LRFD Bridge Design Specifications.
5. The minimum coefficient of friction on PTFE surfaces used for bearing design shall be those corresponding to 68° F in Table 14.7.2.5-1 of the AASHTO LRFD Bridge Design Specifications.
6. The anchorage of the sole plates, masonry plates, and guide bars to the supporting structural element shall be designed for the maximum horizontal design force per bearing shown in the Plans, or 10 percent of the maximum unfactored vertical design force per bearing, whichever is greater.
7. The sole and masonry plates shall have leveling capabilities.
8. The guide bars shall maintain all guided components within the guides at all points of translation and rotation of the bearing.

B. Alternative Bearing Type: The Contractor may propose an alternative bearing type with the exception that pot bearings will not be permitted. Use of an alternative bearing type is subject to approval of the Engineer.

1. Comply with the requirements of these specifications particularly with respect to the friction coefficients used for the design.
2. Any adjustments to the geometry and details presented on the contract drawings will be made at no additional cost to the Authority. The revision work will be performed by the Engineer of Record and the cost of the work will be passed through to the Contractor.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications. The disc bearing manufacturer shall have a minimum of five years experience in the fabrication of disc bearings, and shall meet the additional testing requirements as specified in this specification.

B. Submit the name of the disc bearing manufacturer with a certification of disc bearing manufacturing experience to the Engineer for approval. The certification of experience shall include a list of at least three disc bearing installations performed by the bearing manufacturer on previous projects. The list shall include the following information for each installation:

1. Project Name and Location (Bridge name and highway number).
2. Date of installation.
3. Governmental Agency/Owner.
4. Name, address, and phone number of the Governmental Agency's/Owner's representative.

C. Do not begin preparation of the design calculations and shop plans until receiving the Engineer's written approval of the bearing manufacturer's certification of experience.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS AND SOURCES OF SUPPLY

A. Disc Bearings shall be one of the following, or approved equal:

1. RJ Watson (Alden, NY)
2. DS Brown Company (North Baltimore, OH)

2.02 MATERIALS

A. Steel embedded plates, masonry plates, and sole plates shall conform to ASTM A709 Grade 50, and the dimensions shall comply with the details as shown in the Plans. Steel plates designed by the bearing manufacturer (upper and lower bearing plates and guide bars) shall conform to either ASTM A36 or A709 Grade 36 or Grade 50. All steel shall be zinc metalized in accordance with ASTM B833.

1. The surface of the steel plates and bars in contact with stainless steel shall have an average surface roughness of 125 micro-inches or less.
2. The surface of steel plates in contact with the polyether urethane disc, and the surface within the recess of steel plates and bars retaining PTFE, shall be grit-blasted to an average surface roughness of 250 micro-inches or less.
3. All other steel plate and bar surfaces in contact with other disc bearing assembly components shall have an average surface roughness of 500 micro-inches or less.

B. Polyether Urethane: Polyether urethane shall conform to Section 18.3.2.8 and Table 18.3.2.8-1 of the AASHTO LRFD Bridge Construction Specifications, current edition and latest interims.

C. Polytetrafluoroethylene (PTFE): PTFE shall be 100 percent virgin dimpled PTFE conforming to Section 18.8.2 of the AASHTO LRFD Bridge Construction Specifications, current edition and latest interims.

D. Stainless Steel: Stainless steel sheet shall conform to ASTM A240, Type 304L. Stainless steel in contact with PTFE shall be polished to a Number 8 mirror finish. Stainless steel countersunk screws shall be hexagon socket type conforming to ANSI B 18.3 and shall conform to ASTM F593, Type 304L.

E. Silicone Grease and Epoxy Gel: Silicone grease shall conform to US Navy QPL AS8660-2. Epoxy gel shall be Type I, Grade 3, Class A, B, or C.

F. Bolts, Nuts and Washers: Bolts, nuts and washers shall conform to Section 05120 and shall be galvanized after fabrication in accordance with AASHTO M 232.

G. Anchor Bolt Assembly

1. Anchor bolts shall conform to ASTM F1554 Grade 55, including supplemental requirements S2, S3, and S5.
2. Nuts shall be heavy hex, galvanized and conform to ASTM A563 Grade A.
3. Washers shall be galvanized and conform to ASTM F436.
4. Steel bars or plates shall conform to ASTM A709 Grade 36 or Grade 50.
5. Pipe shall conform to ASTM A53 Grade B Type E or S, black.
6. The upper portion of the anchor bolts, and associated nuts and washers, to six inches minimum below the concrete surface, shall be galvanized after fabrication in accordance with AASHTO M 232.

2.03 FLATNESS AND MANUFACTURING TOLERANCES

A. Determine flatness of bearing surfaces by the following method:

1. Place a precision straightedge, longer than the nominal dimension to be measured in contact with the surface to be measured as parallel to it as possible.
2. A feeler gauge having an accuracy of 0.001 inches equal to the tolerance allowed shall be selected and inserted under the straightedge.
3. If the feeler gauge does not pass under the straightedge, the surfaces shall be acceptable for flatness.
4. In determining the flatness, the straightedge may be located in any position on the surface being measured.
5. Flatness tolerances shall be defined as follows:
   a. Class A tolerance = 0.0005 x nominal dimension[1]
   b. Class B tolerance = 0.001 x nominal dimension[1]
   c. Class C tolerance = 0.002 x nominal dimension[1]

   [1] Nominal dimension shall be taken as the actual dimension of the plate or sheet under the straightedge, in inches.)

B. Manufacturing tolerances for the bearings are as follows:

1. Polyether Urethane Disc
   a. Diameter: ± 1/8 inch
   b. Thickness: -0, + 1/16 inch
   c. Flatness: Class B tolerance
   d. Discs shall be manufactured from a single piece.
2. Sole, Bearing, Masonry, and Sliding Plate
   a. Plan dimensions
      (1) Greater than 30 inches: -0.00, +3/16 inch
      (2) 30 inches or less: -0.00, +1/8 inch
   b. Thickness: -1/32, +1/8 inch
   c. Flatness:
      (1) Side in contact with steel, polyether urethane disc, or PTFE
      Class A tolerance
      (2) Side in contact with grout or concrete
      Class C tolerance
3. Guide Bar
   a. Length: ± 1/8 inch
   b. Section dimensions: ± 1/16 inch
   c. Flatness: Class A tolerance, side in contact with steel
   d. Bar to bar tolerance: ± 1/32 inch
   e. Bars shall be not more than 1/32" out of parallel
4. PTFE Sheet
   a. Plan dimensions: Total nominal design area –0, +5 percent
   b. Thickness: -0.00, +1/64 inch

c. Flatness: Class A tolerance

5. PTFE Recess

a. Length and width –0.00, +0.04 inch

6. Stainless Steel Sheet

a. Flatness: Class A tolerance

b. Overall Height, Total thickness: -1/16, +3/16 inch

c. Break the edges of all components by grinding so that there are no sharp edges.

2.04 SPECIAL FABRICATION REQUIREMENTS

A. When the following components are shown in the Plans as part of the disc bearing assembly, the following special fabrication requirements shall apply:

1. Sole Plate and Masonry Plate: The sole plate and masonry plate shall be 3/4 inches minimum thickness, unless otherwise shown in the Plans.

2. PTFE Sheet

a. The thickness of solid PTFE sheet shall be a minimum of 1/8 inch and a maximum of 3/16 inch. Solid PTFE sheet shall be recessed for a depth equal to one-half of its thickness into the material it is bonded to.

b. The PTFE shall be dimpled, unfilled and have a maximum thickness of 3/16 inch. Dimples shall be placed on a 1/2 inch grid and have a depth of 1/16 inch.

c. The PTFE sheet shall be recessed and chemically bonded to the supporting steel plate. For on a vertical or inverted surface, the PTFE sheet may be mechanically fastened to the substrate with stainless steel countersunk screws. Bonding shall be performed under controlled conditions and in accordance with the written instructions of the PTFE manufacturer.

d. Following the bonding operation, the PTFE surface shall be smooth and free from bubbles.

3. Stainless Steel Sheet

a. The stainless steel sliding surface shall completely cover the PTFE surface in all operating positions plus one additional inch in all directions.

b. The stainless steel shall be 14 gauge thick for the main sliding surfaces and 10 gage thick for the guide bars.

c. The stainless steel sheet shall be seal welded all around to the supporting steel plate or bar by the gas tungsten arc welding (GTAW) process in accordance with current AWS D1.5 specifications. The stainless steel sheet shall be clamped down to have full contact with the supporting steel plate or bar during welding. The welds shall not protrude beyond the sliding surface of the stainless steel sheet.

4. Guide Bar: Fabricate each guide bar from a single steel plate. Connect the guide bars to the disc bearing assembly by recessing and bolting or welding. Face the guiding surfaces with opposing strips of stainless steel and PTFE. No metal-to-metal contact will be permitted. Chemically bond and mechanically fasten the PTFE. Weld the stainless steel sheet to the guide bar before attaching the guide bar to the disc bearing assembly. The space between the guide bar and the guided component shall be 1/16 inch ± 1/32 inch.

2.05 CORROSION PROTECTION

A. Zinc-Metalizing. Steel components, other than of stainless steel, are to be zinc-metalized in accordance with AWS C.2.18-93 to a coating thickness of 6 mils. Indicate the surface to be metalized on the shop drawings. Galvanizing is not permitted for bearing components.

B. Paint exposed surfaces of all zinc-metalized bearing components, except as otherwise specified, in accordance with Section 09910 using system designation S-2S. Paint the weld surfaces fastening stainless steel to structural steel as specified for structural steel. Do not paint stainless steel. Paint galvanized fastening hardware (anchor bolts, bolts, nuts and washers).

C. Apply all coats of paint for steel surfaces in the shop. Repair all surfaces with damaged paint after the disc bearing assembly has been erected in its final position with the anchor bolt nuts installed.

D. Apply all coats of paint for galvanized fastening hardware after the disc bearing assembly has been erected in its final position with the anchor bolt nuts installed. Prepare the galvanized surfaces for painting in accordance with the ASTM D6386. Use only hand or power tool cleaning methods.

2.06 SHOP INSPECTION

A. Provide for inspection, as specified in the Bearing Inspection and Acceptance subsection of this Specification. Inspection during the fabrication process shall ensure that the materials and workmanship meet the requirements of the contract.

B. Perform Quality Assurance Inspection and Final Shop Inspection by an independent inspection entity approved by the Engineer. Submit the name, address, phone number and contact person of the inspection entity performing the required certified shop inspection of the bearings to the Engineer for approval. Do not begin bearing fabrication until receiving the Engineer's written approval of the inspection entity for the certified shop inspection.

2.07 BEARING TESTING PROCEDURE

A. Submit the name, address, phone number, and contact person of the testing entity performing the required bearing testing specified in Bearing Testing subsection of this Specification to the Engineer for approval.

B. The testing entity shall be one of the following:

1. An independent testing agency.
2. The disc bearing manufacturer, with independent verification by the inspection entity performing the certified shop inspection of the bearings.
3. Do not begin bearing fabrication until receiving the Engineer's written approval of the testing entity.

2.08 BEARING TESTING

A. Provide for testing of the bearings. Perform the testing by the testing entity submitted by the Contractor and approved by the Engineer as specified in the Bearing Testing Procedure subsection of this Specification.

B. All testing specified herein that is performed by the bearing manufacturer shall be witnessed by the inspection entity performing the certified shop inspection of the bearings.

C. When fabrication of the bearings is complete, perform a Proof Load test, a Rotation test, and a Coefficient of Friction test on bearing assemblies randomly selected from the production bearings. Test one bearing per lot where one lot is defined as follows:

1. A lot shall be those bearings presented for acceptance at a specific time or date.
2. A lot shall not exceed 25 disc bearing assemblies in number.
3. A lot shall consist of bearings of the same type (fixed, expansion, or uplift), with vertical load capacities differing by no more than 500 kips.

D. Perform the Proof Load test on the selected test bearing assemblies as follows:

1. Apply a proof load of 150 percent of the design capacity of the bearing at a rotation of 0.02 radians for a duration of six hours.
2. Use a bevel plate with a taper equal to a rotation of 0.02 radians.
3. Disassemble the bearing after completing the specified load duration and inspect for wear and damage.
4. The test bearing shall show no signs of defects and failure while under load, and after disassembly and inspection.

E. Perform the Rotation test on the selected test bearing assemblies as follows:

1. Load the bearing to 75% of the design vertical load capacity while simultaneously subjecting the bearing to a rotation of 0.02 radians for a duration of one hour.
2. Use a bevel plate with a taper equal to a rotation of 0.02 radians.
3. The test bearing shall have no separations of plates from each other or from elastomer or PTFE surfaces. There is no lift-off of the plate/urethane interface at the 0.02 radians rotation.

F. Perform the Coefficient of Friction test on the selected test bearing assemblies as follows:

1. Load the bearing to the design vertical load capacity while simultaneously subjecting the bearing to a rotation of 0.02 radians.
2. Use a bevel plate with a taper equal to a rotation of 0.02 radians.
3. Determine the first movement static and dynamic coefficients of friction, at a sliding speed of 1.0 inches/minute or less. Subject the bearing to 100 cycles of sliding movement with amplitude 1.0 inches or greater and speed 1.0 foot/minute or less. Determine the 101st movement static and dynamic coefficients of friction. Note any deformation or cold flow of PTFE.
4. The test bearing shall show no signs of deformation or cold flow of PTFE.

G. Failure of the test bearing for any of the tests will result in rejection of all bearings in the lot being tested.

H. The test bearing may be used as a production bearing provided:

1. The test results meet with the approval of the Engineer.
2. The test bearing was selected from the production bearings.

I. Bearing Inspection and Acceptance

1. Satisfy three levels of inspection before the bearings are accepted. These are: Quality Control Inspection, Quality Assurance Inspection, and Final Shop Inspection. Provide for both Quality Control and Quality Assurance Inspection. Provide access for the Final Shop Inspection. The three levels of inspection are described below:

   a. Quality Control Inspection

      (1) During the fabrication process of all major components, provide full time Quality Control Inspection to ensure that the materials and workmanship meet or exceed the minimum requirements of the contract. Quality Control Inspection shall be the responsibility of the manufacturer's quality control group that shall be independent of the fabrication group.

   b. Quality Assurance Inspection

      (1) Perform Quality Assurance Inspection by the independent inspection entity performing the certified shop inspection, as submitted by the Contractor and approved by the Engineer. Submit the independent inspection entity, the proposed Quality Assurance Inspection Program, and the forms to be used for the Quality Assurance Program to the Engineer for approval prior to the start of fabrication. Quality Assurance Inspection is not required to be full time inspection, but shall be done at all phases of the manufacturing process. The frequency of inspection shall be included in the Quality Assurance Inspection Program.

   c. Final Shop Inspection

      (1) Prior to shipping the bearings to the job site, inspect a representative number of bearings by the independent inspection entity at the manufacturer's facility. Provide a clean, dry, and enclosed area for the bearing inspection. Disassemble and reassemble the bearings for inspection by the Independent Inspection Agency. The independent inspection entity shall certify that the bearings have been inspected, and that the bearings have been manufactured in full compliance with the contract requirements.

   d. The bearings shall satisfy each of the three levels of inspection described above before they will be accepted. Bearings that fail any one of the three levels of inspection shall be replaced or repaired as approved by the Engineer at no additional expense to the Authority. Submit all proposed corrective procedures by the Contractor to the Engineer for approval before beginning corrective work.

2.09 BEARING ASSEMBLY INSPECTION REPORTS AND CERTIFICATES

A. Submit the daily inspection reports of the independent inspection entity performing the required certified shop inspection to the Engineer for approval. The daily inspection reports shall report on the shop fabrication and testing activities relating to the bearing assemblies, and their conformance to the specification requirements.

B. Submit written documentation from the bearing manufacturer certifying that the bearing assemblies have been manufactured in full compliance with the specification requirements.

C. Do not ship the bearing assemblies from the fabricator's facility until receiving the Engineer's approval of the certified shop inspection daily inspection reports and the bearing manufacturer's certificate of compliance.

PART 3. EXECUTION

3.01 BEARING COMPONENT ASSEMBLY, SHIPPING AND STORAGE

A. Fully assemble at the manufacturing plant each bearing, except bearing components welded to the bottom flange of steel girders, and delivered to the construction site as a complete unit, ready for installation. Hold the units together with removable restraints so that the sliding surfaces are not damaged. Place softeners under the restraints to protect all painted surfaces. Do not damage the painted surfaces while shipping, storing and installing the bearing assemblies.

B. Mark all bearing assemblies with the following information prior to shipping:

1. Location of the bearing, including the pier and the specific location along the pier.
2. Direction arrow pointing in the ahead on station direction.

C. Mark the above information on the top plate of the upper unit of the bearing assembly. The marks shall be permanent and shall be visible after bearing installation.

D. Mark centerlines of the bearing assemblies on both upper and lower units for checking alignment in the field.

E. Ship the bearing assemblies in light-proof, moisture-proof and dust-proof containers.

3.02 BEARING ASSEMBLY FIELD INSPECTION

A. Field inspection of a representative number of bearings assemblies will be performed by the Engineer. Provide a clean, dry and enclosed area at the site, spacious enough for the field inspection activities. Disassemble and reassemble the bearings for inspection by the Engineer. The disassembly and reassembly of the bearings shall be in accordance with the bearing manufacturer's written procedure and in the presence of the Engineer.

B. Replace or repair bearings that fail the inspection, as approved by the Engineer, at no additional expense to the Authority. Submit all proposed corrective procedures to the Engineer for approval before beginning corrective work.

3.03 BEARING ASSEMBLY INSTALLATION

A. Install the disc bearing assembly in accordance with the installation procedure included with the shop drawing submittal as approved by the Engineer.

B. Apply a thin uniform film of silicone grease to the entire dimpled PTFE sheet before installation (fill all dimples with grease).

C. For disc bearing assemblies with PTFE and stainless steel components, take special care at all times to ensure protection of the PTFE and stainless steel surfaces from coming in contact with concrete and any other foreign matter.

D. When bearing assemblies are supporting steel superstructure, the interface between the sole plate and the steel girder flange (or the upper and lower sole plates when separate) set with epoxy gel just before setting the superstructure in place. The (lower) sole plate surface in contact with the epoxy gel shall receive a thin uniform film of silicone grease, to prevent bonding to the epoxy gel.

1. Grease the threads of the sole plate clamping bolts to prevent bonding and allow future removal. Apply the epoxy gel by troweling it onto the bottom surface of the steel girder flange or the upper sole plate welded to the steel girder flange and immediately bolt the (lower) sole plate in place to obtain a level surface.

2. Grease and Epoxy gel: US Navy QPL AS8660-2

E. Before the epoxy gel has cured, set the superstructure in place, squeezing out the excess epoxy gel while filling the interface between the steel surfaces. Remove excess epoxy and grease immediately. Tighten to snug tight the sole plate clamping bolts after the epoxy gel has cured.

END OF SECTION

SECTION 13086

DISC BEARINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Design Calculations

1. Submit design calculations for all the bearing components, including the polyether urethane disc, shear pin, bearing plates, sole plates, masonry plates, guide bars, and anchor bolts to the Engineer for approval. The design calculations shall accompany the shop plans.
2. The calculations shall include, but not be limited to the following information:
   a. Bending stresses in the plates due to bearing pressure at maximum design load and eccentricity.
   b. Concrete bearing pressure under the plates at maximum bearing pressure and eccentricity.
   c. Bearing clearances at maximum load and rotation. The calculated clearances shall include the effects of anticipated initial set and modified center of rotation.
   d. Shear stress in the shear pin at maximum horizontal load.
   e. Design of all connections and mating surfaces.
   f. Compressive stress on all sliding surfaces at maximum and minimum design loads, including rotation.
3. Do not begin bearing fabrication until receiving the Engineer's written approval of the calculations.

B. Shop Drawings

1. Submit shop drawings that include but not limited to the following information:
   a. Bearing schedule identifying location and bearing type as described in subsection Bearing Types of this Specification.
   b. Minimum and maximum horizontal and vertical service loads.
   c. Magnitude and direction of movements at all bearing support points.
   d. Minimum and maximum rotation capacity.
   e. Construction rotation requirements.
   f. Plan and elevation of the assembled bearing and each of the components showing dimensions and tolerances.
   g. Complete details of all components and sections showing all materials incorporated into the bearing.
   h. All AASHTO, ASTM, and other material designations.
   i. All surface finishes.
   j. Bearing manufacturer's recommendations and procedures for bearing assembly shipment, storage, and installation.

2. Do not begin fabricating the disc bearings until receiving the Engineer's approval of the shop drawings.

C. Submittals of Acceptance Test Reports and Certificates

1. Submit the following production samples, and test reports and certificates, to the Engineer for review, testing, and approval:

   a. Manufacturer's certificate of compliance for the polyether urethane, PTFE, resin filler, and silicone grease.

   b. A six inch by six inch by 1/8 inch sample of PTFE taken from the lot of production material.

   c. Certified mill test reports for all steel and stainless steel materials incorporated in the bearings.

   d. Do not ship the bearings from the fabricator's facility until receiving the Engineer's written approval of all production samples, and test reports and certificates.

D. Certification of Experience (3 Projects)

1. Project Name and Location (Bridge name and highway number).
2. Date of installation.
3. Governmental Agency/Owner.
4. Name, address, and phone number of the Governmental Agency's/Owner's representative.

END OF APPENDIX "A"

DIVISION 13

SECTION 13124

NJ RESIDENT ENGINEER OFFICE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for the design and construction of a field office for the Resident Engineer (RE) and staff on the New Jersey side of the Kill van Kull in Bayonne, NJ, along with a steel and fabric garage for a Police tow truck. Construct RE's Office with modular housing units integrated into a single office facility. The construction site resides entirely on the Authority's property.

B. Related Work specified in other Sections of the Specifications includes the following:

1.	Section 02110	Excavation, Staging, Handling, Transportation, and Disposal of Hazardous Materials for the West First Street Site in Bayonne, New Jersey
2.	Section 02112	Excavation, Staging, Handling, Transportation, and Disposal of Non-Hazardous Materials for the West First Street Site in Bayonne, New Jersey
3.	Section 02221	Excavation Backfilling and Filling (BBNCP)
4.	Section 02231	Aggregate Base Course
5.	Section 02272	Soil Erosion and Sediment Control
6.	Section 02575	Pavement Milling
7.	Section 02553	Asphalt Concrete Paving
8.	Section 02588	Traffic Paint Pavement Markings
9.	Section 02610	Exterior Sanitary Sewer System
10.	Section 02720	Manholes and Drainage Structures
11.	Section 02722	Storm Drainage System (Infiltration/Ex-filtration Testing Not Required)
12.	Section 02831	PVC-Coated Steel Chain Link Fence and Gates
13.	Section 02851	Aluminum Sign Panels
14.	Section 02920	Soil Testing
15.	Section 02930	Seeding
16.	Section 03100	Concrete Formwork
17.	Section 03200	Concrete Reinforcement
18.	Section 03301	Portland Cement Concrete, Long Form
19.	Section 05506	Miscellaneous Steel
20.	Section 06100	Rough Carpentry
21.	Section 15410	Plumbing Piping and Appurtenances
22.	Section 15430	Plumbing Specialties

23.	Section 15440	Plumbing Fixtures
24.	Section 15491	Plumbing Insulation
25.	Section 15501	HVAC Piping and Appurtenances
26.	Section 15855	Air Handling Units
27.	Section 15860	Centrifugal Fans
28.	Section 15890	Metal Ductwork and Accessories
29.	Section 15931	Air Outlets and Inlets
30.	Section 15939	Motors and Motor Controllers
31.	Section 15940	Vibration Isolation and Control
32.	Section 15945	HVAC Insulation
33.	Section 15992	Testing, Adjusting, and Balancing of Air and Hydronic Systems
34.	Section 16120	Wires, Cables, splices, terminations (600V or less)
35.	Section 16127	Control/Signal Transmission Media
36.	Section 16133	Control Panels, Enclosures/Cabinets, and Terminal Boxes.
37.	Section 16140	Wiring Devices
38.	Section 16860	Electric Heaters

1.02 SYSTEM DESCRIPTION

A. Design and construct the field office of modular housing units adapted to the requirements of this specification and the Basic Contract Drawings provided.

1. Minimum net area: 3,260 SF.
   a. If the facility is mounted above grade, provide a skirt around the perimeter.
2. Provide and maintain heat tracings on all plumbing lines.
3. Each window shall have a full size insect screen and guards as well as sunshades.
4. Each entrance shall have two doors, one with a screen, the other solid with crossbars with padlocks also keyed alike.
   a. Provide forty (40) keys to entry doors and padlocks.
   b. Interior doors shall have separate locksets.
5. Provide furniture and equipment for the field office as indicated. Specific program requirements are listed in Section 1.04.
6. The Contractor shall be responsible for:
   a. Maintain the facility and systems until issuance of the Certificate of Final Completion.
   b. Provide all required utilities, services, and connections for the office including water, sewer, electric service and fiber optic.
      (1) Provide new electrical meter service and the feed to the office.
      (2) Provide new water service.
   c. Any utility accounts opened for the contract shall be in the name of the Authority. The Contractor is responsible for the payment of all utility bills for RE's Office (NJ) until issuance of the Certificate of Final Completion of contract.
   d. Connect all sanitary waste from the Field Office to an approved sewage disposal system.

7. The Contractor is responsible for obtaining all necessary approvals for the construction.
8. Provide ramp, deck, and stairs at all entrances.
9. Provide intrusion detection at windows and doors and a building wide fire alarm system; connect both to the central station.

B. Provide a steel and fabric garage structure adjacent to the Police Facility on the New Jersey side of the Kill van Kull. The garage shall be a fabric approximately 35' x 40', with 2 - 12' wide and 14' high garage doors and a man-door located as close as practical to provide access to the temporary field offices. The structure shall include lighting, courtesy power and two power cable reels to plug in diesel engine warmers. The cable reels shall be hanging from the ceiling to the side and front of the vehicle positions in the garage. The ground surface inside the structure shall be paved. The garage doors shall be situated behind a fence gate so when police officers are not present during shifts that the bridge is closed for construction, the area can be secured from the public. Adequate ventilation of the garage structure per NJ Mechanical Code and ASHRAE 62.1 is required.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM International)
ASTM	*Standard Specification for:*
ASTM D420	Site Characterization for Engineering, Design, and Construction Purposes
	American Concrete Institute (ACI)
ACI 318-08	Building Code Requirements for Structural Concrete
	American National Standards Institute (ANSI)
HFS100	Human Factors Engineering of Visual Display Terminal Workstations
	American Institute of Steel Construction (AISC)
13th Edition	Steel Construction Manual
	American Iron and Steel Institute (AISI)
AISI S100-07	North American Specification for the Design of Cold-Formed Steel Structural Members, 2007 Edition, with current supplements
	American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
2009	Fundamentals Reference Manual, Appendix D
	American Society of Civil Engineers (ASCE)
ASCE 7-05	Minimum Design Loadings for Buildings and Other Structures
	City of Bayonne
	Housing and Building Code
	The State of New Jersey: Department of Buildings
2009	International Building Code NJ Edition (IBC-NJ)
2011	National Electric Code (NEC)
2009	International Mechanical Code (IMC)
2009	National Standard Plumbing Code (NSPC)

	International Code Council
2009	International Building Code
	National Fire Protection Association (NFPA)
NFPA 10	Standard for Portable Fire Extinguishers, 2010
NFPA 70	National Electrical Code, 2011
NFPA 72	Fire Alarm and Signaling Code, 2010
	Sheet Metal and Air Conditioning Contractors National Association (SMACA)
3rd Edition	Duct Construction Standards
	Telecommunications Industry Association
TIA-455-176, FOTP-176	Method for Measuring Optical Fiber Cross-Sectional Geometry by Automated Grey-Scale Analysis
	Underwriters Laboratories (UL)
UL 580	Tests for Uplift Resistance of Roof Assemblies

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Fire Rating: Not rated.
2. Grounding: Ground all structures.
3. Conceal conduit in ceiling for smoke detector wiring for each separate space.

B. Structural:

1. Design the structure to meet the following code and requirements within:
   a. 2009 International Building Code (NJ Edition)
   b. City of Bayonne Housing and Building Code
   c. ASCE 7-05 Minimum Design Loadings for Buildings and Other Structures
   d. American Institute of Steel Construction AISC Steel Construction Manual, 13th Edition
   e. Building Code Requirements for Structural Concrete ACI 318-08
   f. AISI Specification for Design of Cold Formed Steel Structural Members
2. Design for the following live loads (minimum):
   a. Offices/Cubicles: 50 psf
   b. Corridors: 100 psf
   c. Conference Room: 100 psf
   d. Storage Rooms: 125 psf
   e. Stairs and Exits: 100 psf
   f. Roof Live Load: 20 psf
3. Snow Loads
   a. Basic Ground Snow: 50 psf
   b. Exposure Factor, C_e: 1.0
   c. Snow Load Importance Factor: 1.0
   d. Thermal Factor C_t: 1.0

4. Wind Design Criteria (minimum loading):
   a. Basic Wind Speed (3 second gust): 110 mph
   b. Exposure Category: C
   c. Importance Factor: 1.0
5. Seismic Design Criteria (minimum loading):
   a. Occupancy Category: II
   b. Site Class: E
   c. Seismic Design Category: C
   d. Importance Factor: 1.0
   e. Spectral Response Acceleration, SS: 0.360
   f. Spectral Response Acceleration, S1: 0.060
6. Design load reductions based on tributary loaded area shall not be used
7. Roof System Uplift Rating: UL Class 90 wind uplift resistance rating.
8. Combination of Loads: Combine dead, live, wind and seismic loads for design purposes as referenced in the above mentioned Building Codes.
9. Deflections limits (maximum):
   a. Roof system: L/240
   b. Wall system: L/240
   c. Floor system: L/360

C. Site/Civil: Conform to the requirements shown on the Site Plan – NJ Field Office Drawing.

1. Pavement markings shall be painted in conformance with the requirements of Section 02588, Traffic Paint Pavement Markings.
2. Upon completion of the RE office construction, seed side slopes of the newly graded earthwork up to existing ground. Provide seeding for an area out to five feet past the interception of existing ground.

D. Foundations/Geotechnical

Meet the design loadings required by these specifications. Available subsurface investigation data in the area are listed in the clause entitled "Available Documents" in the Division 1 specifications.

1. Geotechnical Documentation
   a. The Contractor (or his designee) is the Engineer of Record for the design and construction under this contract.
   b. Develop detailed Contract Drawings, detailed specifications and other documents that clearly indicate the scope of the Work and materials required for the Work. Include, but not be limited to, the following:
      (1) Detailed Contract Drawings,
      (2) Results of Geotechnical Investigations, Geotechnical Interpretative Report, Foundation Contract Drawings, Sections and Details.
      (3) Detailed technical specifications.
      (4) Shop drawings and submittals are to be approved by the Engineer of Record prior to construction.

2. Geotechnical Investigation and Design: The existing geotechnical documents do not serve as the basis for the design of the field office structure.

a. Plan and perform:

(1) Subsurface investigations and laboratory testing in accordance with Authority procedures and standards,

(2) Interpret the results of the field investigations and laboratory testing programs,

(3) Conduct studies and analyses that incorporate the results of these investigations and tests to provide the basis for the geotechnical and foundation design.

(4) Provide the results of investigations and testing to the Authority for review.

(5) Electronically transmit the logs of borings, laboratory testing results and the field records of any other field investigations to the Authority as each boring or test is completed.

(6) Follow Authority standards except as specified herein, with respect to planning, performing and reporting subsurface exploration programs as defined in Section 1.6 of "The Port Authority of NY & NJ Boring Inspection Manual" listed in the clause entitled "Available Documents" in the Division 1 specifications.

Among the requirements for the borings and laboratory investigations to be performed are the following:

(a.) Supervision - All boring and in situ testing inspection and all laboratory classification and testing shall be performed by qualified technicians under the direct supervision of a licensed professional engineer registered in the State of New Jersey as approved by the Foundation Engineer of Record.

(b.) Location and Ground Surface Elevation - Determine the location coordinates and ground surface elevation for each boring and show both the coordinates and the elevation on the individual boring logs. Coordinates shall be based on the NAD83 horizontal control system. Elevations shall be based on NAVD88 datum. Soil classification shall be performed in accordance with Section 1.6 of "The Port Authority of NY & NJ Boring Inspection Manual" – listed in the clause entitled "Available Documents" in the Division 1 specifications.

(c.) Drilling fluid - All holes shall be drilled using drilling mud with the exception that only water shall be used for holes in which permeability testing shall be performed or observation wells shall be installed. Casing may be used as necessary.

(d.) In accordance with N.J.A.C. 7:9D, Well Construction and Maintenance; Sealing of Abandoned Wells, all casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute non-hazardous waste (e.g., construction and demolition 13C waste) shall be handled in accordance with N.J.A.C. 7:26-2.1. This would include waste material resulting from construction and demolition operations, e.g., wood scrap; tree parts/stumps and brush; concrete, asphalt, masonry; building materials; ferrous and nonferrous metal; non-asbestos building insulation; plastic scrap; dirt; and other miscellaneous materials; not including other solid waste types as classified by NJDEP.

(e.) In accordance with N.J.A.C. 7:9D, Well Construction and Maintenance; Sealing of Abandoned Wells, all casing, cuttings, sediment, displaced water, or free product generated during any drilling procedures (e.g., drilling of shafts and micro-piles) shall be sampled and analyzed per applicable waste characterization parameters to determine if the material is hazardous waste. Any materials determined to constitute hazardous waste shall be handled in accordance with N.J.A.C. 7:26G Hazardous Waste rules.

(f.) Drilling fluid level - The bore hole shall be maintained full of drilling fluid at all times during drilling, including when the rods are being pulled from the hole.

(g.) Bits - Only bits with upward deflected discharge jets shall be used.

(h.) Blow counts - Since the Standard Penetration Test is an index of soil liquefaction resistance during earthquake shaking, care shall be exercised to obtain valid "N" data for this study. Use a consistent procedure in taking each sample and record the information on the logs. The boring procedure shall conform to the following:

i. Use a safety hammer.

ii. Blow Count Rate: Average 40 blows per minute.

iii. Use A or AW drill rod for depths up to fifty (50) feet; N or NW drill rod for greater depths.

iv. Use a sampler with a constant ID = 1-3/8" (i.e., no room for liners in barrel).

(7) Specific data required to be reported on boring logs include the following:

(a.) Boring number based on the sequential numbering system defined by the Authority.

(b.) Laboratory soil classification of soil samples based on Section 1.6 of "The Port Authority of NY & NJ Boring Inspection Manual" - listed in the clause entitled "Available Documents" in the Division 1 specifications. .

(c.) The laboratory-determined water content of each sample taken.

(d.) Groundwater readings.

b. Prepare Geotechnical Report signed and sealed by the Engineer of Record for the foundation design.

c. Include all necessary borings, soil sampling, or other in situ testing needed to provide a basis for the geotechnical and foundation design. Include a laboratory testing program necessary to establish geotechnical design parameters.

(1) Perform all subsurface investigation and laboratory testing in accordance with ASTM D 420, and all applicable ASTM Standards referenced therein.

3. Foundation Design for Field Office Structure .

a. General:

(1) Conform to the requirements of IBC NJ.

(2) Responsibility includes the design and construction of structure foundations in accordance with approved drawings.

(3) Perform all work under the direct supervision of a Professional Engineer licensed to practice in the State of New Jersey and hereinafter referred to as the Engineer of Record.

b. Shallow Foundations

(1) Shallow foundations include spread footings for isolated columns, combined footings for supporting the load from more than one structural unit, strip footings, and mats or raft foundations beneath an entire building area.

(2) Use shallow foundations where there is a suitable bearing stratum near the surface and where there are no highly compressible layers or soils susceptible to liquefaction below.

(3) Consider potentially detrimental substances in soil or groundwater, such as chlorides and sulfates, and provide appropriate protection for reinforcement, concrete and metal piping.

(4) Bearing Capacity: Analyze for bearing capacity to confirm that the underlying soil can resist the footing loads without bearing capacity failure.

(5) Evaluate shallow foundations for their performance under seismic loading. Size shallow foundations subjected to seismic loads such that at least half of the foundation area remains in contact with the soil, and that the applied loads do not exceed the ultimate bearing capacity of the soil. Evaluate punching or local shear failures for shallow foundations.

(6) Settlement: Conduct analyses to estimate the soil settlement induced by the foundation loads. Consider immediate settlements for granular soils and immediate, primary and secondary consolidation settlements for cohesive soils. Establish a settlement criteria in consultation with the modular building fabricator and submit to the Authority for approval. Such criteria shall ensure that no detrimental settlements occur during the five year life of the structure. Such effects include cracking of interior finishes, jamming of windows and doors.

(7) External Stability: Analyze shallow foundations for external stability.

(a.) Include sliding and overturning analyses; global failure analyses.

(b.) Do not consider passive earth pressure in front of the foundation in the evaluation of sliding and overturning failures.

(c.) Design shallow foundations such that the resultant load falls within the middle third of the foundation for non-seismic loading.

E. Mechanical (HVAC): Design HVAC equipment to meet the requirements of:

1. National Electric Code (NEC)
2. International Mechanical Code (IMC)
3. Requirements set forth in Part 2, Products, Section 2.03H.

F. Plumbing: Design plumbing to meet:

1. International Building Code NJ Edition (IBC-NJ)
2. National Standard Plumbing Code (NSPC)
3. Requirements set forth in Part 2, Products, Section 2.03E.

G. Fire Alarm: Design the fire alarm system to meet:

1. National Fire Protection Association (NFPA) Code 72.
2. Requirements set forth in subsection I - Communications, for connecting the fire alarm system to the central command station.

H. Security

1. Security Connection

a. Furnish and install cabling and conduit to allow the access control and intrusion detection system to connect to a stand alone central station.

I. Communications

1. Fiber optic lines to building

a. Furnish, install, test and terminate 4 strand of single mode fiber optic cabling and conduit from the RE Office building communications room to an existing fiber optic patch panel (FOPP) in the enclosure located at West 4th Street and Margaret Street,

b. The FOPP in the RE's Office shall be furnished and installed by the Contractor. The connection from the FOPP to computer and phone equipment will be made by the Authority.

2. Connection for Fire Alarm systems

a. Furnish and install cabling and conduit to allow the fire alarm system to connect to a stand alone central station.

3. Data and Phone system within the building

a. Furnish, install, test, label and terminate cabling and conduit from the RE's Office communications room to all data and phone terminals within the RE Office building.

b. Furnish and install a data/phone cable patch panel (CPP) in the RE's Office. The connection from the CPP to data/phone equipment will be made by the Authority. Cabling shall be unshielded twisted pair (UTP), Category 6. The CPP shall be compatible with UTP, Category 6.

J. Resident Engineer's Office Space Requirements

File Storage	200sf
Small Conference room	250sf
Corner Offices (3)	100sf, minimum
GOCOR Office	100sf with exterior door
Office with Window	100sf, minimum
Communications, Data Room	60sf, minimum
Police Office and Bathroom	180sf with exterior door and no entry to main facility
Admin Area/Mail Room	64sf +/-
Badging Area	100sf
Plotter/Copy Area	150sf
Storage	80sf, each
Entry/Waiting Area	100sf +/-
Open office space (cubicles)	12 at 64sf

1. Facility to include:

a. Men's (1) and Women's (1) restrooms sized appropriately for the number of people

b. Small kitchen

c. Janitor's closet

d. Communications, Data Room

2. Provide maximum occupancy calculations and post maximum occupancy on interior signs at locations approved by the Authority.

1.05 ENVIRONMENTAL REQUIREMENTS

A. There is a potential need for the removal of contaminated soil and/or groundwater from the site for construction of the foundations. Such removal will be paid for under the provisions for Net Cost Work. Removal of contaminated soil and/or groundwater shall comply with the requirements stated in specification sections 02110 and 02112.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Requirements for the manufacturer of the pre-engineered modular building:

1. Regularly engaged in the design and fabrication of pre-engineered, pre-fabricated metal buildings for a minimum period of five (5) years.
2. Furnished such buildings for five similar projects that have been in use for not less than five years.
3. Capable of furnishing compatible auxiliary building components and accessories shown or specified.
4. If requested, furnish to the Authority the names and addresses of five similar projects where the manufacturer's building has been in use for five years.
5. Acceptance will be subject to the approval of the Authority.

B. Installer Qualifications: Requirements for the person supervising the installation of the buildings are:

1. Experienced in pre-engineered modular building installation work for a period of not less than five (5) years.
2. Regularly employed by a company engaged in the erection and installation of such buildings for a minimum of three (3) years.
3. If requested, furnish to the Authority the names and addresses of three similar projects for which the supervisor has supervised the erection and installation of pre-engineered metal buildings.

C. Regulatory Requirements

Comply with the latest edition of the building codes of the State of New Jersey and City of Bayonne Building and Housing Code

D. Inspection

Quality assurance inspections may be made by the Engineer. If quality assurance inspections are made by the Engineer, it shall not relieve the Contractor of responsibility for his/her own quality control program.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver building components to the site in undamaged condition with measures taken to protect the modular sections, contents and finishes.

B. Keep components and materials dry until assembly is completed and accepted for use by the Authority.

C. Handle material by a method that will prevent damage to components.

1.08 MAINTENANCE

A. Owner's Manual/Maintenance Instructions

1. Maintain the field offices until issuance of the Certificate of Final Completion. This includes:

   a. Provide and supervise a professional cleaning service to clean and maintain the field office every week up to the time of final completion.

   b. Replace burned out fluorescent tubes and light bulbs as needed.

   c. Temporary power and utilities will be the responsibility of the Contractor. Accounts opened with local utilities for the project are to be in the name of PANYNJ and payment for utility services will be the responsibility of the Contractor until issuance of the Certificate of Final Completion.

B. Removal

1. After issuance of the Certificate of Final Completion, or as directed by the Authority, the Contractor shall remove the temporary office facilities from the NJ Site and the NY Site, discontinue the temporary services, and repair both Sites and finish the areas as directed by the Port Authority.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of one of the following, or approved equal:

1. Modular Building Systems.
2. Vanguard Modular Building Systems.
3. Allied Modular Building Systems.

2.02 MATERIALS

1. Color and Finishes will be selected by the Authority from manufacturer's standard palette.

2.03 CONSTRUCTION FEATURES

A. Frame

1. Steel perimeter frames with removable hitches
2. New brake axles

B. Floor

1. Steel cross-members @ 36" OC mounted inside frame
2. 3/4" Tongue and groove plywood floor decking over 22 gauge steel B-deck
3. Vinyl composition block tile floor covering – wet areas
4. 26 Oz. commercial grade level loop carpet with unitary backing – all areas other than wet areas, vapor barrier.

C. Walls and Partitions

1. 2" x 4" wall studs @ 16" OC
2. Partition walls per floor plan (interior walls to underside of roof decking if required by code)

3. 5/8" Vinyl clad gypsum (Type-X, fire-rated) wall covering with 1" batten strips and 4 mil vinyl
4. 0.060 FRP wainscot @ 48" AFF in bathrooms and janitorial closet
5. Pre-finished, 20-minute fire-rated, interior doors with Redi-frame steel frames
6. Grade 1 interior lever door hardware – keyed, privacy, and passage
7. Prefinished vinyl cove base molding package with 4" vinyl base molding (6" vinyl base in bathrooms)

D. Roof

1. Transverse roof design with wood trusses @ 16" OC shall meet wind speed requirements
2. 8" Perimeter projection mansard overhang
3. 7/16" OSB, Class C, FR roof decking
4. Wood clearspan beams where required – no visible support posts
5. 60 Mil Black EPDM roof covering
6. Suspended ceiling @ 8'-0" AFF with 2' x 4' white acoustical ceiling tiles in white grid

E. Plumbing

1. One (1) electric water heater sized as required for maintaining hot water at fixtures.
2. ADA compliant bathrooms per Basic Contract Drawings – each with:
   a. One (1) elongated tank type commode with grab bars
   b. One (1) 19" x 17" lavatory with single lever faucet mounted in laminate countertop
3. Bobrick, or approved equal, stainless steel fixtures for each bathroom with:
   a. Double roll toilet paper dispenser
   b. Toilet seat tissue dispenser
   c. Liquid soap dispenser
   d. C-fold paper towel dispenser
   e. 18" x 30" mirror with shelves
   f. Clothes hook
4. 4" Floor drains, one (1) per bathroom
5. One (1) 24" x 24" x 8" Terrazzo mop sink with wall-mounted faucet, hose, and mop hanger for janitor's closet
6. Two (2) ADA compliant electric water fountains with chilled water
7. One (1) 20" x 20" Stainless steel sink with gooseneck faucet (kitchen)
8. Water line for refrigerator ice-maker
9. Type L copper supply piping with cut-offs for interior piping
10. Cast iron waste piping with stub outs through floor for interior piping

F. Electrical

1. Single-phase load centers, quantity as required, with A/C cable raceway and module crossovers. Ensure 25% spare breaker capacity in each panel.
2. Recessed fluorescent light fixtures (50 ft/candles illumination)
3. Standard fluorescent porch light fixtures with photocells

4. Standard switches and duplex receptacles with 3-way and 4-way switches where required
5. Interior GFI receptacles and dedicated receptacles where required
6. Exterior weatherproof receptacles where required including heat tape receptacle
7. Ceiling-mounted 120-V "pigtails" (for wiring interior work stations by others)
8. Ceiling-mounted communication/data junction boxes with 3/4" EMT conduit (for interior work stations)
9. (120 V) Wall-mounted junction boxes @ 18" AFF with 3/4" EMT conduit stubbed up to ceiling
10. Emergency lights and lighted exit signs where required by code
11. Communication/data closet equipped with:
    a. 3/4" x 4' x 8' plywood telephone back board with fire retardant paint
    b. Two (2) - 3" PVC stub outs through floor, and dedicated quad receptacle
12. Fire alarm system with smoke detection, horn, strobes, emergency egress lighting, and manual pull stations installed per all applicable codes.
13. Special receptacles for copiers, scanners, plotters, in plotter/copier rooms and where required.

G. Fiber Optic Cable

1. The optical fiber cable installation, including all components of the optical fiber cable system such as fiber optics patch panel, connector and splice kit, shall be manufactured and installed in accordance with the requirements of NFPA 70.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.
3. The dispersion un-shifted single-mode fiber utilized in the cable specified herein shall conform to the following requirements:
    a. Single mode, multiple channel; 1310 and 1550 nm for digital applications
    b. Dispersion Un-shifted
    c. WDM capable
    d. Cladding Diameter: 125.0 ± 0.7 μm. Tested in accordance with FOTP-176.
    e. Core Concentricity: = 0.5 μm.
    f. Cladding Non-Circularity: = 1.0%.
    g. Fiber Curl: = 4.0 m radius of curvature
    h. Core Diameter: 8.2 μm typical
    i. Core/Cladding Concentricity Error = 0.8μm tested in accordance with FOTP-176.

H. HVAC – Provide:

1. HVAC units - sized to maintain indoor design temperatures of 75°F cooling and 68°F heating during ASHRAE peak design temperatures.
2. Programmable thermostats
3. Smokestacks and fire dampers where required
4. Sheet metal ducts:
    a. Overhead duct supply system with ceiling-mounted, 4-way diffusers
    b. Overhead return air system with ceiling mounted return air grilles

c. Design HVAC ducts based on SMACA requirements.

5. Insulated plenum walls

6. Ceiling-mounted electric exhaust fans located and sized to meet fresh air requirements. Introduce outdoor ventilation air to the spaces through the HVAC units.

a. Provide exhaust ventilation for all rest rooms.

7. Air filters at the supply air and outside air intakes.

8. Outdoor ventilation air based on code requirements.

9. Interlock area and duct smoke detectors with HVAC systems and tied into the central fire alarm system per all applicable codes.

10. Electric baseboard heaters for perimeter heating.

I. Insulation

1. Floor: R-19 Unfaced fiberglass batts

2. Exterior Walls: R-13 Kraft faced fiberglass batts

3. Roof: R-30 Kraft faced fiberglass batts

4. Interior Walls: R-11 Unfaced fiberglass batts

J. Cabinetry/Millwork in kitchen area

1. 6 LF Oak base cabinets with laminate countertop, backsplash, drawers, and flat panel doors

2. 8 LF Oak overhead cabinets with shelf and flat panel doors

K. Exterior

1. 5/8" CDX sheathing with Dow House Wrap, or approved equal

2. 29 GA High rib steel exterior, trim, and underpinning

3. 29 GA High rib steel vertical mansard with short parapet, concealed roof drain system, and exposed downspouts with extensions and turnouts

4. 36" x 60" Vertical sliding, Low E insulated windows with bronze finish frames, and 1" metal mini-blinds

5. 1 ¾" x 36" x 80" Steel insulated exterior doors with steel frames, 6" x 30" glass view-blocks, closers, panic hardware, exterior pull handles, and Grade 1 interchangeable cores as per programmatic and code requirements

6. 1 ¾" x 36" x 84" Commercial insulated glass and steel exterior door with wide stile, bronze frame, tinted glass, closer, and Grade 1 interchangeable rim cylinder cores, one (1) per building

L. Miscellaneous

1. Provide ABC type, 10 pound fire extinguishers mounted in semi-recessed cabinets as defined and in accordance with NFPA 10.

M. Glass and Glazing

1. Provide 48" wide by 36" high sliding transaction window with lock at wall between Administration area and Entry.

2. Glass to be laminated, frame to be steel, painted to match adjacent walls.

N. Code Information

1. IBC, Chapter 3 – Business Occupancy, New Jersey Modular Label

2.04 ACCESSORIES

A. Furniture

1. General:
   - a. Baked enamel painted finish on all exposed steel surfaces.
   - b. Full height modesty panel
   - c. Steel panel leg design on all desks
   - d. All pedestals shall be suspended
   - e. Desk tops shall have two (2) wire grommets
   - f. Provide plastic laminate top with bullnose edge design
   - g. Chair shall have fabric upholstery
   - h. All chairs shall meet ANSI HFS100.
2. Manufacturers shall be:
   - a. Steelcase, Inc.
   - b. All Steel Company
   - c. Haworth
   - d. Approved equal
3. Furniture Units:
   - a. Desk: one per office
     - (1) Double pedestal - L shaped desk 72 x 72 IN
     - (2) Four (4) box, one (1) file drawer; center drawer
   - b. OF-3 Desk:
     - (1) Single left or right hand pedestal with 26 IN high L-return
     - (2) L-return to have single pedestal with one (1) box and one (1) file drawer
   - c. Executive Chair:
     - (1) One per office, 12 in small conference room
     - (2) High back
     - (3) Open arm, field replaceable
     - (4) Knee tilt, full swivel
     - (5) Pneumatic seat height adjustment
     - (6) Fabric upholstery
     - (7) Hard dual wheel, five (5) caster base
   - d. Task Chair: One per cubicle
     - (1) Low back, adjustable backrest height, fully upholstered
     - (2) Open cantilevered arms, field removable, upholstered
     - (3) Pneumatic seat height adjustment
     - (4) Hard dual wheel, five (5) caster base
   - e. Guest Chair: one per office and 2 in front entry
     - (1) Open Arms
     - (2) Vinyl or Fabric Upholstery
   - f. Lateral Files: one 2 drawer per office, 2 per file storage/copy room
     - (1) 2 drawer and 4 drawer

(2) Width: 36IN

(3) Integral pull

(4) 18 IN deep

(5) Lockable

(6) Drawers with hanging frames side to side

g. Vertical Legal File Cabinet:6

(1) 5 drawer

(2) Lockable

(3) Integral pull

(4) 18 IN wide x 28 IN deep

(5) Hanging frames

(6) Anti-rebound feature

h. Conference Table: 144 IN long: for small conference room

(1) "T" base, three (3) bases on tables over 96 IN long

(2) Laminate top with wood bullnose edge

(3) Painted column and scuff resistant base

(4) Hard dual wheel caster base

i. Waste Paper Basket: one per space

(1) Rectangular plastic 15 x 8 x 17 IN. black

j. Recycling Basket: one per space

(1) Rectangular plastic 15 x 8 x 17 IN. blue

B. Furnishings

1. Provide an "Open Plan" office furniture system meeting the space requirements of 1.04.J. Provide furnishings for the Open Plan system that are manufactured by one of the following:

a. Knoll - Equity

b. Steelcase - Kick

c. Approved Equal

2. Install Open Plan office furniture system using authorized manufacturer's installer with at least 5 years of experience

a. System shall include all parts, pieces and items required for operation and functional use.

b. Partitions shall be 65" high or manufacturer's closest equivalent, fabric on both sides. Color will be selected by the Authority from manufacturer's standard palette.

(1) Panels shall be electrified and contain 2 duplex outlets and raceway for network cables.

c. Provide 64 sf cubicles with:

(1) U shaped work surface and supports

(2) One 36" wide, 2 drawer lateral file

(3) One file cabinet of box-box-file configuration

(4) One 36"wide overhead bin with task light

(5) One cabinet +/-65" high by 30" wide

3. Office Equipment:
   a. Plotter/Scanner – Oce Colorwave 300, or approved equal
   b. Copier – Canon C5045, or approved equal (with network interface card)
   c. Mail Station in Admin area – particle board cubby system with 40 slots (each slot 9"w x 12"d by 3"h)
   d. *Flat Filing Cabinet - 10 drawers sized to fit 24" x 36" drawings*
   e. Refrigerator with ice maker, microwave oven in kitchen area
4. Locks
   a. Padlocks for front entry door on the screen door and the solid door to unlock with the same key
   b. Forty copies of the entry door key
   c. Interior doors on offices shall have unique keys

PART 3. EXECUTION

3.01 INSTALLATION and ERECTION

Furnish and install the modular buildings and appurtenances in accordance with the manufacturer's printed instructions for the system approved by the Authority. Work shall be such that the structure is secure and weather-tight, and exposed materials are free of visible dents, scratches, tool marks, cuts, and other imperfections. The building shall be free of rattles, wind whistles and noise due to thermal movement.

3.02 ADJUSTING

Repair minor visual damage to restore the building to factory applied finishes in a manner that matches the appearance and performance of the original finish or remove the damaged parts and replace them with undamaged parts.

END OF SECTION

SECTION 13124

BAYONNE BRIDGE: RESIDENT ENGINEER'S OFFICE (NJ)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

13124A01	Shop drawings and installation procedures for foundation elements such as spread footing, piles, drilled shaft, retaining walls.
13124A02	Bill of Materials as per the approved catalog cuts
13124A03	Terminal block connection diagrams for all system components.
13124A04	Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
13124A05	Layout and details of fabric garage

Catalog Cuts

13124B01	Fiber Optic Catalog Cuts
13124B02	Mechanical Equipment Catalogue Cuts

Samples

13124C01	Samples of SMF to be deployed.
13124C02	Sample splice kit materials and a detailed written procedure for performing fusion splicing prior to start of work.
13124C03	Six complete sets of the samples above to be used for training purposes.
13124C04	Supply standard color samples for exterior wall and roofing panels, trim, and other factory color-coated components. Selection of colors will be made by the Authority.

Product Data

13124D01 Water service pipe material, valves, tap.

13124D02 Sanitary sewer service pipe material.

13124D03 Provide manufacturer's catalog sheets, specifications and installation instructions.

13124D04 Provide manufacturer's catalog sheets, specifications and installation instructions.

13124D05 Provide manufacturer's catalog sheets, specifications and installation instructions.

13124D06 Provide manufacturer's catalog sheets, specifications and installation instructions.

13124D07 Provide manufacturer's catalog sheets, specifications and installation instructions.

13124D08 Provide manufacturer's catalog sheets, specifications and installation instructions for plumbing fixtures, accessories and toilet room casework.

13124D09 Provide manufacturer's catalog sheets, specifications and installation instructions for fabric garage

Manufacturer Test Reports

13124F01 OTDR (Optical Time Domain Reflectometer) image of each fiber in both directions and in each band

13124F02 Bandwidth of each fiber in each band for multimode fibers

Construction and Installation Procedures

13124G01 Detailed technical specifications for foundation elements such as spread footing, piles, drilled shaft, retaining walls.

13124G02 Plans and technical specifications for the geotechnical field investigation program, including but not limited to borings, test pits, field testing and laboratory testing.

Calculations

13124H01 Expected point-to-point Link Loss Budget for each link in the Contract

13124H02 Manufacturer's design calculations, signed and sealed by a New York Registered professional Engineer are required for the foundations, structural framing and exterior wall

and roofing panels.

13124H03 design calculations for cooling and heating loads, outdoor ventilation air requirement, signed and sealed by a New York Registered professional Engineer .

Manuals, Warrantees/Guarantees

13124I01 Provide a 5 year warranty on roofing panels and related trim against rupture, structure failure, or perforation due to atmospheric conditions.

13124I02 Provide a 5 year warranty for factory applied color finish on exterior surface of exterior wall panels.

Schedules

13124J01 Equipment Schedules and or details which define all of the equipment used within the System.

Quality Assurance-Quality Control

13124L01 Geotechnical Report signed and sealed by the Engineer of Record for the foundation design.
Provide an interpretation of the available factual information related to subsoil and groundwater conditions, and based on this interpretation, select appropriate parameters for the design of the work.
Include all necessary borings, soil sampling, or other in situ testing needed to provide a basis for the geotechnical and foundation design.

13124L02 Metal building manufacturer's written certification that the structure has been designed in conformance to the specified design loading and other design requirements.

Record Documents

13124M01 Electronic files for the logs of borings, laboratory testing results and the field records of any other field investigations

Detail Contract Drawings

13124W01 Detailed contract drawings for all building components, foundations, and tie rod details, signed and sealed by a New York Registered professional Engineer.

Detail Contract Specification

13124X01 Detailed specifications for all building components, foundations, and tie rod details.

END OF APPENDIX "A"

13124

DIVISION 13

SECTION 13550

SMART BRIDGE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the installation and operation of the Structural Health Monitoring (SHM) system.

B. The SHM system is comprised of five major components, related to the Contract Drawings:

1. Slow speed strain measurement system
2. High speed strain measurement system
3. Slow speed expansion movement measurement system
4. Data acquisition (DAQ) network
5. Ambient weather measurement system

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Each sensor is to be fastened to the structure in a permanent manner as shown on the Contract Drawings or as approved by the Engineer.

B. All sensors installed in locations where exposure to sun or construction activities could harm the equipment or measurements must be protected as shown in the contract drawings or as approved by the Engineer.

C. Each sensor installation shall have strain relief provided for the corresponding signal cable.

D. For sensors that require the removal of paint on structural steel, provide new paint protection for exposed steel and sensor after installation. Paint protection system should include two coats of primer and one final coat with color as close to existing material as possible, or as approved by the Engineer.

E. Each DAQ is to be grounded to the existing structural steel in a manner which ensures protection from corrosion and sufficient continuity.

F. The DAQ design must provide for wireless communication to external data storage locations.

G. All signal cables, ground wires, and power cables must be isolated from each other to eliminate cross-talk. If it is necessary to cross two cables, it must be done in a manner approved by the Engineer.

H. All enclosures must meet NEMA 4 environmental protection.

I. A sensor labeling scheme shall be provided for transparent identification of each sensor and approved by the Engineer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The manufacturer of all hardware must have demonstrated experience on bridges.
2. The specifications of all hardware implemented must meet the anticipated conditions on-site.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, install and monitor the following products, or approved equal(s):

1. Geokon Vibrating Wire Strain Gages
   a. Attachment Methods: Arc weld, spot weld, or epoxy
   b. Range: 3,000 με
   c. Resolution: 1.0 με
   d. Accuracy: ±0.5% FS
   e. Nonlinearity: <0.5% FS
   f. Temperature Range: -20°C to +80°C
   g. Thermistor: Included with sensor
   h. Thermistor Range: -20°C to +80°C
   i. Thermistor Accuracy: ±0.5°C
2. Hitec Products Electrical Resistance Strain Gages
   a. Gage Length: 1.0 inches
   b. Shim Dimensions: 2 inches by 0.6 inches
   c. Attachment Method: Microdot Welding
   d. Temperature Range: -50° to 180°F
   e. Temperature Compensation: 6ppm/°F
   f. Resistance: 350 ohm
   g. Gage Factor: 2.0
   h. Strain Relief: Stainless Steel Intermediate Wire and Weldable Transition
3. Geokon Vibrating Wire Tiltmeter
   a. Attachment method: mechanical anchor or bracket
   b. Measurement Range: +/- 10° (standard range)
   c. Temperature Range: -4°F to 176°F
   d. Resolution: 8 arc seconds
   e. Accuracy: +/- 0.1%
4. Geokon Vibrating Wire Extensometer
   a. Gage Length: 60 inches
   b. Attachment method: mechanical (clamps)
   c. Measurement Range: 12 inches
   d. Temperature Range: -40° to 120°
   e. Resolution: 0.025% FS

f. Accuracy: +/- 0.1%

g. Nonlinearity: < 0.25% FS

5. Geokon Vibrating Wire Crackmeter

a. Gage Length: 13 - 27 inches

b. Attachment method: mechanical anchor

c. Measurement Range: 0.5 – 6 inches

d. Temperature Range: -4°F to 176°F

e. Resolution: 0.025% FS

f. Accuracy: +/- 0.1%

g. Nonlinearity: < 0.25% FS

6. Vaisala Weather Transmitter

a. Measured Quantities (Range):

(1) Wind Speed

(a.) Range: 0 to 60m/s

(b.) Accuracy: greater of ±0.3 m/s or ±3% (0 to 35m/s); ±5% (36 to 60 m/s)

(c.) Response Time: 0.25s

(2) Wind Direction

(a.) Range: 0° to 360°

(b.) Accuracy: ±3°

(c.) Resolution: 1°

(d.) Response Time: 0.25s.

(3) Precipitation

(a.) Range: Cumulative from Prior Reset

(b.) Accuracy (Daily Accumulation): Better than 5%

(c.) Resolution: 0.01mm (0.001in)

(d.) *Collecting Area: 60 cm^2*

(4) Barometric Pressure

(a.) Range: 600 to 1100 hPa

(b.) Accuracy: ±0.5hPa @ 0° to 30°C; ±1hPa @ -52° to +60°C

(c.) Resolution: 0.1 hPa

(5) Air Temperature

(a.) Range: -52° to +60°C

(b.) Accuracy: ±0.3°C @ +20°C

(c.) Resolution: 0.1°C

(6) Relative Humidity

(a.) Range: 0 to 100% RH

(b.) Accuracy: ±3%RH @ 0 to 90% RH; ±5% @ 90 to 100% RH

(c.) Resolution: 0.1% RH

(7) Input Voltage: 50 to 30 Vdc (maintain at least 5.3 V)

(8) Output Format: SDI-12

(9) Operating Temperature: -52° to 60°C

7. Campbell Scientific Data Acquisition and Requisite Peripherals

Equipment	Description	Number Required	Dimensions			Operating Temp. Range	Humidity	Power Input	Other Relevant Characteristics
			L (in)	W (in)	H (in)				
CR3000	Micrologger Data Acquisition	5	9.5	7.0	3.8	-20° to +50°C	0 to 95%	10 to 16 Vdc	16 Bit A/D with a Max sampling rate of 100Hz
PS200	Power Supply with Smart Charging Regulator	5	7.5	4.2	3.0	-40° to +60°C	NA	NA	-
MD-485	RS-485 Multidrop Interface	5	6.3	2.5	0.8	-20° to +50°C	0 to 95%	12 Vdc	Maximum cable length between units is listed as 4000'
RF401	Spread Spectrum Radio Modem	2	4.8	2.8	1.3	-20° to +50°C	NA	9.6 to 16 Vdc	Frequency Band: 910 to 918 MHz
NL115	Ethernet Interface and Compact Flash	5	4.0	3.5	2.5	-40° to +85°C	NA	12Vdc	Requires industrial grade CF cards up to 2GB
AM16/32B	16/32 Channel Relay Multiplexer	5	9.4	4.0	1.8	-20° to +50°C	0 to 95%	9.6 to 16 Vdc	-
AVW200	2 Channel Vibrating Wire Spectrum Analyzer	5	8.5	4.4	1.3	-20° to +50°C	0 to 95%	9.6 to 16 Vdc	-
4WFSB350	Bridge Completion for 350 Ω Sensors	52	0.5	0.5	0.5	-55° to 85°C	NA	NA	-
GPS16X-HVS	GPS Synchronization Sensor	5	3.5	3.5	1.7	-30° to 80°C	Any	8 to 40 Vdc	Factory set to sample at 1Hz

B. All sensors shall be ordered with requisite lengths of instrumentation cable from the approved manufacturers above, or approved equal(s).

PART 3. EXECUTION

3.01 PREPARATION

1. All sensors, cables, data acquisition, and requisite software shall be tested and programmed prior to any field work.
2. Locations where power and cellular connections will exist shall be verified on site with the Engineer.

3.02 INSTALLATION

1. Install instrumentation as shown on the Contract Drawings. Any modification to the specified sensor locations must be approved by the Engineer.
2. All tools, sensors, equipment, and any other object which may fall during installation must be tied off to the installer.
3. The installer must observe fall protection requirements associated with the nature of each installation activity.

4. The steel surfaces must be prepared according to the manufacturer specification to ensure appropriate bonding of the sensor to the structure.

3.03 FIELD QUALITY CONTROL

A. Field Tests

1. After installation of each sensor, a basic sensor quality test must be performed. For vibrating wire sensors, a readout box shall be used to obtain on-site measurements. For all other sensors, electrical resistances of the leads shall be measured to ensure the sensor is within manufacturer specifications after installation.

B. Inspections

1. All sensor installations must be inspected after installation and testing is complete to ensure the bonding and the protection system is sufficient.
2. All sensor installations must be inspected for alignment to minimize erroneous measurements.
3. All cabling must be inspected to ensure power and signal cables are not collinear and are appropriately installed.

3.04 ADJUSTMENTS

1. Based upon the findings of the field test and inspections, if a sensor is misaligned or has failed a field test, the sensor must be repaired if possible, or replaced. After a sensor is repaired or replaced the field test and inspection must be repeated.

3.05 PROTECTION

1. After the installation of the sensor, the cable must be strain relieved to the structure.
2. All sensors are to be protected as indicated in the Contract Drawings or as approved by the Engineer.
3. Where hardware presents a fall hazard, all equipment must have a redundant fall protection system to prevent losing equipment or presenting a hazard to workers or motorists.

END OF SECTION

SECTION 13550

Smart Bridge Specifications

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

13550A01	Drawings showing details and locations of all fiber optic network receptacles
13550A02	Drawings showing details and locations of all power receptacles

Schedules

13550J01	Detailed procedures for how the arch structure is to be removed of paint, painted, strengthened, and constructed

END OF APPENDIX "A"

DIVISION 13

SECTION 13705

ACCESS CONTROL SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the Access Control System (ACS) to fully integrate this System with the Authority's ACM2 Architecture providing distributed servers implemented within the Authority.

B. The system functions shall be user to configurable include, but not be limited to, Access Control, Alarm Monitoring, Credentialing, and integration and synchronization with Video Surveillance for the areas as shown on the Contract Drawings to ensure that operators can identify and coordinate alarms with the appropriate camera displays.

C. The ACS Server system is to be furnished and installed by the Authority. . The Contractor is responsible for furnishing and installing all the related ACS server system components.

D. For ACS and video software integration, the Contractor shall be responsible for furnishing, installing and configuring the CCTV interface and Software Development Kit (SDK) requirement to enable the ACS to automatically display camera views associated with alarm events. In addition, the CCTV interface shall enable the ACS to view prerecorded video associated with alarms defined in the ACS.

E. Regional Lenel ACS servers furnished and installed under this contract shall be interfaced and configured to communicate with the Enterprise Lenel ACS Servers at the Goethals Bridge facility.

F. Contractor shall be responsible for integrating and configuring an alarm event with at least 3 levels of priorities. Contractor shall verify with Engineer for configuration events.

G. Contractor shall provide method and capability for assigning alarms. Contractor shall verify with engineer for configuration assignment.

H. The ACS's and Video Surveillance Systems integration shall allow for the creation of graphical maps, which would permit the display of dynamic icons, camera call ups, presets, door lock, door unlock, etc.

I. Related Work specified in other Sections of the Specifications includes the following:

1. Division 8 Section 08715 – Finish Hardware
2. Division 13 Section 13710 – Video Surveillance System – Cameras
3. Division 13 Section 13715 – Video Surveillance System – Monitoring and Control

4. Division 13 Section 13720 – Video Surveillance System – Recording and Storage
5. Division 16 Section 16450 – Grounding
6. Division 16 Section 16670 – Lightning Protection System
7. Division 16 Section 16728- Electronics Equipment Racks and Communication cabinet

1.02 SYSTEM DESCRIPTION

A. Contractor is to furnish and install Access Control System as on Contract Drawings. This includes, but is not limited to the following:

1. Intelligent System Controller
2. Dual Reader Interface Modules
3. Input Control Module
4. Output Control Module
5. Access Control Panel Hardware
6. Uninterruptible Power Supply (UPS) with 120V, 750 VA, 1 phase circuit from electrical panel.
7. Electromagnetic Door Locks for security gate on the bridge structure
8. Electromagnetic enclosure door locks for access control panels' and field equipment panels' enclosures.
9. Electrified Mortise locks for doors inside New York's and New Jersey's Mechanical Electrical Buildings.
10. Door Monitoring Switch
11. Horn and Strobe
12. Motion Detector
13. Emergency Phone Control Inputs
14. Cypress Extender SPC-1300
15. Access Control System Servers & Database implementation
16. Access Control System Software & Database Software.
17. System Software Package
18. Traka Key Management System
19. Power Supply with 120V, 1 phase circuit from electrical panel.
20. All conduit, wiring (copper and fiber) and items required to integrate the intent of the access control components at this location into the overall access control/security system.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C39.1	Electrical Analog Indicating Instruments
ANSI/IEEE 829	IEEE Standard for Software Test Documentation
	ASTM International (ASTM)
ASTM A 123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
	Building Code of the City of New York (BCCNY)
	Code of Federal Regulations (CFR)
47 CFR Part 15	Rules and Regulations, Radio Frequency Devices, Field Disturbance Sensors
	Electrical Code of the City of New York (ECCNY)
	Electronic Industries Association (EIA)
EIA 232	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
EIA 485	Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
	Federal Specifications (FS)
FS J-C-30	Cable and Wire
	National Electrical Manufacturer's Association (NEMA)
NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and System
	National Fire Protection Association (NFPA)
NFPA 70/72	National Electric Code (NEC)
NFPA 75	Standards for the Installation Maintenance and Use of Protective Signaling Systems
	Underwriters Laboratories (UL)
UL 50	Protection of Electronic Computer/Data Processing Equipment
UL 294	Access Control System Units
UL 634	Magnetic Contacts (Security Switches)
UL 636	Holdup Alarm Units and Systems
UL 681	Installation and Classification of Mercantile and Bank Burglar Alarm Systems
UL 796	Printed Wiring Boards
UL 1076	Proprietary Burglar Alarm Units and Systems
UL 1610	Central Station Burglar Alarm Units

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. All ACS components shall be of the most highly developed technology currently available, in manufacture and performance. The system shall include all necessary components required to make a complete and operable system and shall maintain or exceed an uptime availability of 99.97%. All software products which are not site-specific, or otherwise specified public domain software packages (such as the operating system, spreadsheets, word processing program, etc.) shall be manufactured by the Security System Manufacturer, as part of their standard product offering and shall not be custom produced for this application. This standard product software shall be modular in structure, enabling future system upgrades for additional capabilities to be easily accomplished, by installation of specific subroutines without requiring modification of existing system configuration

B. All ACS equipment shall work together as an integrated system. The installed and operating ACS shall be integrated into the overall facility to deter intrusion and shall perform as an entity, as specified below. All products shall be manufactured by the ACS manufacturer, unless otherwise shown on the Contract Drawings.

C. The ACS shall be expandable, meeting all specification criteria herein, to at least double the number of input and output points specified in this Section and Contract Drawings without additional firmware or software.

D. All equipment shall be on site and fully tested with all communications paths operational prior to commencing any existing ACS removals unless otherwise noted on the Contract Drawings and with prior approval by the Authority.

E. ACS Operating Requirements: Provide a complete operational system ready for the defined environmental requirement, with all necessary components. Provide auxiliary items required for proper functioning of the entire ACS system, whether mentioned or not, including but not limited to: heaters, insulation, wiring, transformers and relays. It is the Contractor's sole responsibility to provide every component necessary for a complete and functioning system, except for those specifically excluded.

1. All ACS primary components shall be microprocessor controlled.
2. All ACS system equipment shall have compatible communication ports with selectable baud rates for all communications. The Contractor shall provide communication ports for connection to all computer hardware.
3. All ACS system equipment/devices shall be capable of storing and communicating comprehensive data on features provided with system.
4. All field programmable functions of each piece of equipment shall be capable of being reprogrammed from the primary CPU software.
5. The Contractor shall be responsible for ensuring that all specified features are provided and are fully operating when the Contractor indicates to the Authority that the system is ready for testing and acceptance. The Contractor shall also be responsible for ensuring that the system meets or exceeds the performance, availability and functional requirements stated herein.
6. The Contractor will be responsible for ensuring that hardware and software communications are properly received and sent by both the access management software and peripheral devices and access control panels.

F. Server Redundancy: The ACS system shall support a fault tolerant server and redundant database architecture complies with PA ACM2 architecture. It shall allow for normal operations to occur in the event that the Database Server fails. In the event of a server failure, the switch over to a backup server shall be automatic. System Operator intervention for switch over shall not be acceptable.

1. The ACS system shall utilize two servers, which shall be configured identically. One server shall be designated as the Primary Server and the other shall be designated as the Backup Server. The Primary Server shall be the main server that is in use when the ACS system is operating under normal conditions.

2. The ACS system shall mirror the database information from the Primary Server to the Backup Server. This mirroring shall be conducted through standard local area network (LAN) communications. There shall absolutely not be any proprietary communication links between the Primary and Backup Servers.

3. In the event that the Primary Server fails, the Backup Server shall sense that the Primary Server has failed and is no longer on the network. The Backup Server shall check to see if the Primary Server is online every five (5) seconds.

4. Upon sensing Primary Server failure, the Backup Server shall automatically take control and initiate itself as the Primary Server within five (5) seconds of failure detection.

G. Alarms: Alarms shall include but not be limited to the following:

1. Include interior point protection sensors, as specified in the Contract Drawings.

2. Tamper Switches: Enclosures, cabinets, housings, and boxes, with hinged doors or removable covers which contain circuits of the intrusion detection system and associated power supplies shall be provided with covers having corrosion resistant tamper switches. Arrange tamper switches to initiate an alarm signal when the door or cover is moved as little as 1/4 inch from the normally closed position. Mechanically mount tamper switches to minimize defeat time when enclosure covers are opened or removed. The time required depressing or defeating the tamper switch after opening or removing the cover shall be equal to or less than 500 ms. Enclosure and tamper switch shall prevent direct line of sight to internal components and prevent switch or circuit tampering. Conceal mounting hardware so switch shall not be observed from enclosure exterior. Covers of junction boxes provided to facilitate initial installation of the system need not be provided with tamper switches if covers contain no splices or connections. Tamper alarms shall be clearly distinguishable from intrusion detection alarms. Tamper switches on doors which shall be opened to make normal maintenance adjustments to the system and to service power supplies shall be the push/pull set, automatic reset type. Tamper switches shall be:

   a. Inaccessible until switch is activated;

   b. Under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating;

   c. Spring-loaded and held in the closed position by the door, or cover protected;

   d. Wired to break the circuit when the door or cover is disturbed; and

   e. Wired so that each sensor and device is annunciated individually.

3. Fail-Safe Capability: Provide fail-safe capability in all access control panels, CPUs, printers, UPSs, and other critical elements of the Access Control System. This shall include, but not be limited to, capability to monitor communication link integrity and to provide self test. When diminished functional capabilities are detected, system shall provide annunciation of the fault. Fail-safe alarms shall be annunciated to be clearly distinguishable from other types of alarms.

4. Line Fault Detection: As a minimum, fault isolation at the systems level shall have the same geographic resolution as provided for intrusion detection. Communication links of the Access Control System shall have an active mode for line fault detection. System shall be either a static or dynamic system. In a static system, the "no-alarm" condition shall always be represented by the same signal, which shall be different than the signal originally transmitted. The dynamic system shall represent "no alarm" with a signal which continually changes with time.

5. Power Loss Detection: The ACS shall detect when a component of the system experiences temporary or permanent loss of power and shall signal an alarm. Alarms shall be annunciated at the Primary CPU to clearly identify the component experiencing power loss.

H. Alarm/Event Routing

1. The ACS shall be capable of allowing System Administrators to route alarms and events to various Alarm Monitoring client workstations on the network. The ACS shall allow any alarm or event to be routed to one or multiple client workstations on the network regardless of where the alarm is generated in the field. Alarms shall be routed to client workstations on a device by device level.

2. The ACS shall also allow for the System Administrators to automatically have alarms re-routed from one Alarm Monitoring client workstation to another Alarm Monitoring client workstation if a system operator has not responded to the alarm within a specified amount of time

3. The ACS shall have network synchronization so that if an alarm/event is routed to multiple client workstations, once the first client workstation 'grabs' the alarm, the alarm/event shall be cleared from all other client workstations. As such, alarms that are routed to an Alarm Monitoring client workstation which does not have a System Operator logged in shall be queued so that all unacknowledged alarms will report to that client workstation once a System Operator has logged into the system.

4. The ACS shall have network synchronization so that if an alarm/event is routed to multiple client workstations, once the first client workstation 'grabs' the alarm, the alarm/event shall be cleared from all other client workstations. As such, alarms that are routed to an Alarm Monitoring client workstation which does not have a System Operator logged in shall be queued so that all unacknowledged alarms will report to that client workstation once a System Operator has logged into the access control system.

5. Alarms/Events shall be routed based on default settings or timezone control. The ACS shall allow for alarms and events to be placed into groups that can then be assigned to monitor zones. Each alarm/event that is associated with a group can have its own unique timezone association. The group shall later be used to define when that alarm/event shall be routed to the assigned Alarm Monitoring client workstation.

I. Alarm Attributes

1. The System Administrator shall have the capability to configure how the ACS handles the annunciation of alarms on an individual basis. Each alarm and/or event shall have the option(s) to:

   a. Display at one or more Alarm Monitoring client workstation.

   b. Allow higher priority alarms to be displayed on the Alarm Monitoring client workstation ahead of lower priority alarms.

   c. Require that the field device that generated the alarm be restored to its normal state before the alarm can be cleared from the Alarm Monitoring window.

   d. Print the alarm to the local event printer.

   e. Have a customized voice message annunciate at the client workstation.

   f. Have the alarm breakthrough to the Alarm Monitoring window should the System Operator be working on another application on the Alarm Monitoring client workstation.

   g. Allow System Operators to change the journal entry once the alarm has been acknowledged.

   h. Require that the alarm not be deleted from the Alarm Monitoring window upon acknowledgment.

   i. Display text and audio instructions outlining the procedures to follow when responding to the alarm.

   j. Automatically call-up associated maps upon grabbing an alarm.

   k. Automatically call up the associated cardholder record with photo when the alarm displays.

   l. Automatically call up the associated cardholder photo in the video verification function when the alarm displays for comparison to a live video image at the card reader.

   m. Require System Operators to enter in a password to view the alarm.

   n. Require System Operators to enter in a password to acknowledge the alarm.

   o. Require System Operator acknowledgment to clear.

   p. Allow mandatory journal entry upon acknowledgment.

   q. Have pre-defined "canned" journal entries for alarms in the SYSTEM.

   r. Allow non-essential events to be cleared without requiring System Operator journal entry, while other alarms shall require System Operator journal entry.

   s. Send appropriate CCTV camera preset commands to Video Management System.

   t. Automatically send an e-mail message to one or more e-mail recipients.

   u. Automatically send an alphanumeric page to one or more pagers.

   v. Have the alarm appear on the Alarm Monitoring window with a flashing colored bar across the alarm for high priority alarms. Each priority in the OnGuard software shall have its own unique color assigned to it. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.

w. Have the alarm, when acknowledged, display a different flashing colored bar across the alarm than for the original alarm color. Each acknowledged priority in the ACS shall have its own unique color assigned to it. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.

x. Have a function list(s) assigned to it that will trigger when the alarm is acknowledged. The function lists shall be configured to execute only within a specified amount of time from when the alarm was generated.

y. Require User Logon for Acknowledgment – This feature shall require a user ID and password to be entered when the given alarm is acknowledged. This ID shall be different than the User ID that is currently logged onto the OnGuard software.

J. Self Test: Provide self test capability for sensors, response devices, display lights, and other elements which are not inherently self testing by virtue of continuous operation. Initiation of a test command shall be available by both automatic and manual means. Provide manual sensor test initiation capability by both the ACS primary central processing unit and at command elements of the alarm reporting and display subsystem. Sensor test command signal shall initiate an intrusion simulation which shall cause the sensor to test as much of itself, including the transducer, as is possible and shall result in the generation of an alarm condition. Automatic sensor test command signals shall be issued by a central processing unit. A test initiation signal shall be issued at specified time intervals.

K. Reliability: System components shall be designed and built to be fault tolerant and fully redundant, as shown on the Contract Drawings, and shall provide the following:

1. Satisfactory operation without damage at 11% above and 15% below rated voltage and at +/- 2 hertz variation in line frequency. The Contractor shall provide power conditioning equipment to compensate for any anomalies created by power disturbances outside of normal operating parameters

2. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Buss connected devices shall be ac coupled or equivalent so that any single device failure, whether the result of either operational or power failure, will not disrupt or halt buss communication.

3. All real time clocks and data file RAM to be battery or capacitor backed. Real time clocks shall be synchronized by a signal transmitted from the Primary CPU.

L. Electrical Power: Obtain electrical power from the electrical distribution system, as shown in the Contract Drawings. Power shall be continuously monitored and, if interrupted, automatic switching from primary to emergency backup sources shall be accomplished without interruption or degradation of critical system function. Upon restoration of prime power, system shall automatically switch back to the primary source. Failure of an on-line battery shall be detected and reported as a fault condition.

1. Primary Power: Obtain primary power as shown on the Contract Drawings. Provide a lockable circuit breaker to match existing, at each power panel, as required.

2. Backed Power Supply: Provide backup by dedicated battery backed power supply to provide uninterrupted operation for remotely located system elements such as individual motion sensors and fence sensors, magnetic door locks, etc, and other access control equipment. Power supply shall be Underwriters Laboratory listed for general purpose use, tested to meet UL 1012 specifications. Power supply output voltage shall be filtered and regulated. Power supply shall include an integral battery charging circuit. Batteries shall be capable of operation in any position and shall be protected against venting caustic chemicals or fumes within an equipment cabinet. Batteries shall be capable of continuous operation for up to 24 hours without recharge or replacement.

M. Availability: Provide components designed for continuous operation, allowing for a minimum uptime availability of 99.97%. Provide solid-state electronic components, mounted on printed circuit boards conforming to UL 796. Boards shall be plug in, quick disconnect type. Circuitry shall not be so densely placed as to impede maintenance. Power dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Light duty relays and similar switching devices shall be solid-state type or hermetically sealed electromechanical type and shall be equipped with retaining clips. Electrical indicating instruments incorporated into system components shall conform to applicable provisions of ANSI C39.1.

N. ACS Electromagnetic Interference (EMI): ACS components employing electromagnetic radiation shall be designed and constructed to provide maximum practical invulnerability to electronic interference.

O. Electromagnetic Radiation (EMR): Provide only ACS components which are Federal Communication Commission (FCC) licensed and approved. Provide system components which are electromagnetically compatible (EMC).

P. Interchangeability: Like components shall be physically and functionally interchangeable as complete items, without modification of either the original items or of other components with which the items are used.

Q. Safety: ACS components shall conform to application rules and requirements of NFPA 70 and applicable UL publications, as listed in section 1.03 of this specification, entitled "References".

R. Integrated system functional requirements:

1. Ensure that the System is fully compliant and integrated within the AC2M architecture implemented by the Authority, including the seamless operation of the System with the AC2M Regional Servers

2. Ensure that ACS is fully integrated with physical security and all other elements of the overall facility security system. Provide specific subsystems consisting of, but not limited to, the following:

   a. Detection Subsystem: Sensors to detect intrusion attempts.

   b. Access Control Panel Subsystem: Electronic devices to monitor and control personnel movement through normal access routes in and out of the facility and within protected areas throughout the facility and provide means to indicate a duress condition at the location of the primary CPU only.

c. Communications Subsystem: Elements required ensuring that pertinent data is transferred from point of origin to point where appropriate actions shall be taken.

d. CCTV Subsystem: Electronic devices required to provide visual assessment of ACS alarms at various separate locations.

e. Alarm Reporting and Display Subsystem: Electronic devices to control, process, integrate, and annunciate ACS data at two separate locations.

f. Power Subsystem: Components required ensuring continuous operation of the entire ACS.

3. Growth Capability: Provide capability for modular ACS expansion with minimal equipment modification. Products provided shall not limit growth capability to products of a single manufacturer.

4. Database Growth: The ACS shall be sufficiently configured such that a 15% per year growth in proximity cards and transaction activity can be supported for three years without purchasing additional hardware, modifying the software or suffering any performance or availability degradation.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Interior Conditions: Equipment installed in environmentally protected interior areas shall be housed in corrosion resistant type NEMA 1 rated stainless steel enclosures and shall meet performance requirements specified for the following ambient conditions:

1. Temperature: Components installed in heated security protected areas shall meet performance requirements for temperatures between 32 to 120 degrees F. Components installed in unheated security protected areas shall meet performance requirements for temperatures between zero and 120 degrees F;

2. Pressure: Sea level to 15,000 feet above sea level;

3. Relative Humidity: 5 to 95 percent;

4. Fungus: Components shall be constructed of non fungus nutrient materials or shall be treated to inhibit fungus growth; and

5. Acoustical Noise: Components shall be suitable for use in high noise areas above 100 dB, without adversely affecting their performance.

B. Exterior Conditions: Components mounted in locations exposed to weather shall be housed in corrosion resistant NEMA 4X rated stainless steel enclosures. Component performance shall not degrade because of improper housing design. Components in enclosures shall meet performance requirements when exposed to the following ambient conditions:

1. Temperature: -25 to +140 degrees F;

2. Pressure: Sea level to 15,000 feet above sea level;

3. Solar Radiation: Six hours of solar radiation at dry bulb temperature of 120 degrees F including 4 hours of solar radiation at 104 watts per square foot;

4. Sand and Dust: Wind driven for gusts up to 120 miles per hour;

5. Rain: Two inches per hour and 5 inches per hour cyclic with wind plus one period of 12 inches per hour;

6. Humidity: 5 to 95 percent;

7. Fungus: Warm, humid atmosphere conducive to the growth of heterotrophic plants;

8. Salt Fog: Salt atmosphere with 5 percent salinity;

9. Snow: Snow loading of 48 pounds per square foot; blowing snow of 60 mph;

10. Ice Accretion: Up to 2 inches of radial ice;

11. Wind: Up to 60 mph with gusts to 120 mph

12. Acoustical Noise: Components shall be suitable for use in high noise areas above 110 dB without adversely affecting their performance.

13. Shock: 30G at 3 millisecond duration (operating)

14. Vibration:

    (1) 5 to 10 Hz at 0.030 inches double amplitude displacement

    (2) 10 to 200 Hz at 0.15G peak

    (3) 200 to 500 Hz at 0.77G peak

15. Lightning and Power Surges:

    a. ACS units and related communication circuits shall be properly protected against excessive voltages. This requirement shall apply for circuits that are routed both in underground and overhead conduit runs. As a minimum, install primary protection devices, such as three electrode gas type surge arresters, and secondary protectors to reduce dangerous voltages to levels that shall cause no damage. In all cases, Contractor shall follow Lightning and Surge Protection and Grounding standards in the References cited in this Specification.

    b. ACS units and related communication circuits shall be protected from voltage surges originating external to rooms, equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1.06 QUALITY ASSURANCE

A. The system software shall be an existing, commercially available product of similar type and complexity and shall have been successfully operated at least in two other locations for not less than two years.

B. Regulatory Requirements: Provide only UL listed ACS equipment except for exterior ACS sensors, access control, and closed-circuit television (CCTV) components. All electronic equipment shall conform to the requirements of 47 CFR 15 governing radio frequency electromagnetic interference and be so labeled. This system must also carry New York City Materials and Equipment Acceptance Division approval.

C. Qualifications

1. System Integrator: Shall have a minimum of 5 years prior experience and technical expertise in performing contracts comparable in size and complexity as described in this Section, and that the work was performed skillfully, in a satisfactory manner, and on time. Said contracts shall consist of a minimum of three (3) installations, one (1) of which shall be located in the United States, which shall have included ACS work, comparable in type size, and complexity as described in this Section. Said installations shall have been in satisfactory operation for the last three consecutive years, minimum, and shall have included at least one contract which required the installation of an ACS in an existing facility.

2. System Integrator:

   a. The AC and its components shall be supplied by one System Integrator, who shall be responsible for the integration of the ACS and its components into a fully operational system that meets the requirements of this Section. Contractor shall be of established reputation and experience, who shall have furnished and provided technical assistance, and who shall have performed systems integration for the installation of Access Control and Intrusion Detection Systems, of similar size, type, and complexity as described in this Section, manufactured by the same System Manufacturer who equipment the Contractor furnishes in this Contract, for the last five (5) consecutive years, eighteen months of which shall be with the same system, including all major hardware, software, and firmware components, the Contractor furnishes in this Contract.

   b. The System Integrator's prior experience shall consist of a minimum of three (3) installations, one (1) of which shall be located in the United States. These installations shall be in satisfactory operation for a minimum of three (3) years.

   c. The System Integrator's prior experience shall also include at least one (1) installation which uses the same System Manufacturer and the same Access Control and Intrusion Detection System, including all major hardware, software, and firmware components, as the Contractor furnishes in this Contract. Said installation shall be in satisfactory operation for a minimum of six (6) months.

   d. The System Integrator shall demonstrate, to the satisfaction of the Engineer, that the projects conforming to the subparagraphs a., b., and c. above were completed on time and in full satisfaction of Contract requirements. Said demonstration shall take the form of names and telephone numbers of Authority's representatives who can provide information about these projects, locations of the installed equipment, length of service, and dollar amounts of Contracts, description of work, and scheduled and actual start and completion dates.

3. Manufacturer: The system manufacturer shall have a minimum of two (2) manufacturer authorized maintenance subcontractors which have maintenance personnel and resources available within the Port Authority District, as evidenced by existing contracts, to provide maintenance for systems comparable to the system described in this Section.

4. Instructor: who will train operating and maintenance personnel, has received a minimum of 24 hours of ACS training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in the installation of ACS of the type specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original unopened protective packaging.

B. Store materials in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible maintain protective coverings until installation is complete and remove such covers as part of the final clean-up.

E. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

1.08 GUARANTEES

A. The ACS shall be warranted against defects in materials and workmanship for a one year period commencing on the date of satisfactory completion of the 30 day operational test performed in accordance with the requirements of this Section. The warranty shall cover all components, system software, parts and assemblies supplied by the Contractor. The warranty shall also cover labor to troubleshoot, repair, reprogram, or replace system components, and travel to and from the Bayonne Bridge Facility. Emergency service for all system equipment shall be available on a 24 hour a day, 7 day per week basis, with a maximum two hours response time.

B. The Contractor shall perform all maintenance required for the work of this Section for a period commencing on the date of satisfactory completion of the 30 day operational test performed under this Section and ending on the first anniversary of the Base Date for Contract, all at no additional cost to the Authority. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on Authority and Contractor archived software EPROMs and disks.

C. All product software and firmware modifications, upgrades, and revisions made by the manufacturer for a period of five years following the warranty period shall be updated on all user documentation and on Authority and Contractor archived software EPROMs and disks. Said product software and firmware modifications and revisions shall be provided to the Authority free of charge.

1.09 MAINTENANCE

A. Prepare and submit System operation and maintenance manuals. If standard manufacturer's reference manuals are to be utilized, they shall be enhanced with a site specific introduction and detailed narratives preceding each section to explain how individual section contents relate to the System as installed and configured for operation as Work of this Contract. These manuals shall be made available and utilized during the Factory Acceptance Testing as a means of checking their accuracy and completeness.

B. The Contractor shall prepare the project Customized Operations Manual. The Operations Manual shall contain custom test, photographs, and drawings for the installed System, with detailed instructions on how to perform day-today operational tasks. Include:

1. Overview of installed system architecture

2. Operations Run Book
3. Detailed description of normal system operation
4. Error and Alarm Handling Procedures
5. System Start up and Shutdown Procedures
6. Use of Various Logs and Output Data by Operator to Improve System Efficiency
7. Description of Operating Procedures
8. Alarm Sequence of Operations
9. Alarm Database Reports
10. Administration terminal and Operator Workstation screenshots
11. Graphic Map Display screenshots
12. Camera Database Reports
13. Digital Encoding Device Database reports

C. The Contractor shall prepare the project Customized Maintenance Manual: The Maintenance Manual shall contain custom text, photographs, and drawings for the installed, with detailed instruction on how to perform diagnostics, regular preventive maintenance and replacement on all components. Include:

1. Detailed description of installed system architecture
2. Hardware description, including description of all equipment and nameplate data. Include catalog cuts.
3. Drawings showing all equipment locations
4. Photographs of typical equipment locations with individual rack or enclosure identified
5. Functional block diagrams
6. Drawings showing interconnection of all equipment.
7. Operating Procedures.
8. System start-up and shut-down procedures
9. Diagnostic and test procedures for system and all hardware
10. System back-up and restoration procedures.
11. Comprehensive factory service manuals shall be provided for individual equipment types showing theory of operation, wiring diagrams, voltages, and parts lists including diagnostics, adjustment and configuration procedures.
12. Recommended service and test procedures including hardware replacement, card replacement, adjustments, and preventive maintenance procedures and materials, routine operations, and guide to troubleshooting, description of sequence of operation. Include manufacturer's product data with each sheet annotated to clearly identify the data applicable to the installation and deleted references to inapplicable information.
13. Recommended routine maintenance procedures and schedules (e.g. daily, weekly, monthly, etc.)

14. Special maintenance requirements (if any)

15. Hardware configuration information, including device naming, model numbers and serial number of equipment, MAC addresses IP addresses and port assignments.

16. Special configuration requirements

17. Include copy of each manufacturer's warranty and give information sheet for proper procedures in the event of failure and instances, which may affect the validity of warranties.

1.10 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Specification, furnish and install products of one of the following manufacturers:

2.02 MATERIALS

A. Access Control System (ACS) capabilities and components:

1. Furnish all hardware and software required to provide the following operational capabilities:

   a. Provide an electronic method for controlling access to designated portals (doors or other entryways) based on specified personnel access criteria.

   b. Monitor access control security alarm devices to report alarm conditions, access granted or denied, tampering, doors held open, doors forced open, deactivated portals, and related conditions.

   c. Maintain stored log files and real-time printed logs of system activity.

   d. Permit generation of a variety of reports on system activity and database files.

   e. Interface with CCTV and alarm systems.

   f. Permit a change in operating procedures after the initial programming has been done.

   g. Accommodate future additional alarm zones and access portals. Expandability of 100% is required for future contracts.

   h. Provide a database for security searches.

   i. Operate by reading the Authority's currently used (at time of submittal) contactless iClass Smart Cards.

   j. Lockable enclosures must be equipped with Securitron or approved equal locks.

   k. Provide Cypress extender SPX -1300 for the door located with longer distance.

2. Access Control System Software

a. Manufacturer: Lenel OnGuard version 6.5 or latest as manufactured by Lenel (no substitution).

3. The access control system shall include the software licenses; software licenses shall be as required for system compatibility with the existing server. Configure the computer to be fully capable of all functions specified herein.

a. The access control system license shall be as follow:

(1) Lenel SWS-ENTREG1Lenel, which includes OnGuard Server software licenses for System Administration, License Server, Import, Replication Administration, Login Driver, Communication server, SWG-1240 database segmentation, support for up to 128 card access readers and first year support plan SUSP-W-ENT-REG, or Approved Equal.

(2) Lenel SWS-PRO-REDU, which includes OnGuard Redundant Server software licenses for System Administration, License Server, Import, Communication Server, CCTV Interface, Video Verification, Guard Tour, Automatic E-Mail Interface, Login Driver, Account Linkage support for up to 128 card access readers, and first year support plan SUSPW-PRO-REDU, or Approved Equal.

(3) Lenel SWC-ADV OnGuard ADV Client Software License, which includes OnGuard Client software licenses for System Administration, Alarm Monitoring, MapDesigner, Communication Server and Login Driver, or Approved Equal.

(4) If future installation exceed 128 card access readers, the PRO-64RUP Reader Capacity Upgrades on OnGuard PRO/ENT Systems shall be purchased, which provides an additional 64 Access Readers licenses for all PRO systems.

(5) All other third-party software that required for full installation, operation and maintenance of ACS system.

b. Connect multiple components of the access control system at any facility via a LAN connection.

B. Intelligent System Controller

a. Manufacturer: Lenel 3300 Intelligent System Controller as manufactured by Lenel (no substitution).

2. It shall provide full distributed processing of access control, alarm reporting and remote control operations. It shall be capable of supporting the required numbers of dual reader interface modules, input control modules and output control modules.

3. The controller shall be equipped with flash memory for real-time program updates, and have dedicated inputs for tamper and power-failure status.

4. It shall be designed to operate on either 12 VDC or 12 VAC.

5. It shall be capable of communicating with the host computer in a single path or dual path configuration of IP, direct connect communications (RS-232/485). It shall be equipped with a network interface card (or port) for IP.

6. It shall have a minimum of 15 MB on–board memory.

7. The controller shall be the LNL-3300 as manufactured by Lenel System International, Inc. and as distributed by Henry Brothers Electronics, Fair Lawn, NJ, telephone 201-794-6500, or approved equal.

C. Dual reader interface module

a. Manufacturer: Lenel LNL-1320 Series 2 as manufactured by Lenel (no substitution). Furnish power supplies as required

2. Shall be capable of supporting two card reader units. It shall have eight inputs that support normally open, normally closed, supervised, and non-supervised circuits. It shall have six output relays to support fail-safe or fail-secure operation.

3. It shall be designed to communicate directly with the Intelligent System Controller either by 2-wire RS-485 or 4-wire RS-485 communication, and have dedicated inputs for tamper and power-failure status.

4. It shall provide door contact supervision (open/closed); it shall provide REX push-button monitoring and strike control output.

5. It shall be designed to operate on either 12/24 VDC or 12 VAC.

D. Output Control Module

a. Manufacturer: Lenel LNL-1200 Series 2 as manufactured by Lenel (no substitution). Furnish power supplies as required

2. Shall have a minimum of 16 programmable output relays that can be configured for fail-safe or fail-secure operation. Each relay shall support "On", "Off" and "Pulsed" software commands.

3. Shall have a minimum of 16 programmable output relays that can be configured for fail-safe or fail-secure operation. Each relay shall support "On", "Off" and "Pulsed" software commands.

4. It shall be designed to communicate directly with the Intelligent System Controller either by 2-wire RS-485 or 4-wire RS-485 communication and have dedicated inputs for tamper and power failure status.

5. It shall be designed to operate on either 12VDC or 12 VAC.

E. Input Control Module

a. Manufacturer: Lenel LNL-1100 Series 2 as manufactured by Lenel (no substitution). Furnish power supplies as required

2. Shall have a minimum of 16 configurable input control points and 2 output control relays. It shall support normally open, normally closed, supervised and normally supervised circuits.

3. Is shall be designed to communicate directly with the Intelligent System Controller either by 2-wires RS-485 or 4-wire RS-485 communication and have dedicated inputs for tamper and power failure status.

4. It shall be designed to operate on either 12VDC or 12 VAC.

F. Access Control System Regional Server Hardware

1. The ACS Regional Server hardware shall be the IBM model number 3650 M3. This Server shall be furnished by the Authority. All application and program installation shall be performed by the Contractor.

2. Shall be equipped with Microsoft Windows Server 2008 R2 with Service Pack 1.

3. Shall be equipped with Microsoft SQL Server 2008 or SQL 2008 Express.

   a. The ACS regional server shall be configured in RAID 10 configuration

   b. The Contractor shall integrate and test the ACS System within the Port Authority's AC2M architecture, fully utilizing the regional servers' capabilities and meeting the requirements of these servers for fault tolerant operation.

G. Access Control System Regional VMware Server Hardware

1. The ACS Regional VMware Server hardware shall be the IBM model number 3650 M3. This Server shall be furnished by the Authority. All application and program installation shall be performed by the Contractor.

2. Shall be equipped with Microsoft Windows Server 2008 R2 with Service Pack 1.

3. Shall be equipped with Microsoft SQL Server 2008 or SQL 2008 Express.

4. Should have the following characteristics:

   a. The ACS regional VMware server shall be configured in RAID 10 configuration

   b. The Contractor shall integrate and test the ACS System within the Port Authority's AC2M architecture, fully utilizing the regional servers' capabilities and meeting the requirements of these servers for fault tolerant operation.

H. Access Control System Database Server Hardware

1. The ACS Regional Database Server hardware shall be the IBM model number 3650 M3. This Server shall be furnished by the Authority. All application and program installation shall be performed by the Contractor.

2. Shall be equipped with Microsoft Windows Server 2008 R2 with Service Pack 1.

3. Shall be equipped with Microsoft SQL Server 2008 or SQL 2008 Express.

   a. The ACS database server shall be configured in RAID 10 configuration

   b. The Contractor shall integrate and test the ACS System within the Port Authority's AC2M architecture, fully utilizing the regional servers' capabilities and meeting the requirements of these servers for fault tolerant operation.

I. Alarm Monitoring Client/Administration Laptop

1. The ACS alarm Monitoring Client/ Administration Laptop shall be Lenovo ThinkPad W520. This Laptop will be furnished by the Authority. All application and program installation shall be performed by the Contractor.

2. The alarm monitoring and client workstation shall be IBM Thinkstation S30 . This workstation will be furnished by the Authority. All application and program installation shall be performed by the Contractor.

3. The ACS shall allow the configuration of an enrollment and badging client workstation, an alarm monitoring client workstation, and administrative client workstation.

4. The alarm monitoring client workstation must be able to connect to, and monitor, field hardware devices, such as card readers and ISCs. Administrative tasks including defining asset information, access groups, timezones, intrusion detection devices, configuring digital video devices, generating reports, creating maps, etc. shall be provided from any client workstation on the network that is licensed to do so.

5. The ACS System will communicate with the alarm monitoring and client workstation located at the Goethals Bridge facilities.

6. At each site Access Control System cabinet/rack, a workstation shall be installed for the purposes of administrating and monitoring the field hardware devices such as cared readers and Intelligent System Controllers.

7. Other administrative tasks include defining asset information, access groups, timezones, intrusion detection devices, configuring digital video devices, generating reports, creating maps, etc. shall be provided from any client workstation on the network that is licensed to do so.

8. The Administration Laptop Workstation shall be a Windows 7 Professional with Service Pack 1.

J. Power supply with batteries for networked access control system components

1. It shall be switch-selectable to provide a 12 VDC or 24 VDC output.

2. It shall be as specified herein in paragraph 2.2 - Power Supply/Charger for Access Control Equipment.

3. Battery kit shall be Lenel ABT-12, include 12VDC, 12 AH Battery (PS-12120).

K. Card reader, keypad, and combinational card reader-keypad

1. The card reader shall be a proximity reader capable of supporting Wiegand card format.

2. It shall have an operating temperature range of –35° to +65°C.

3. Furnish card reader units in the required quantities as indicated in the Contract Documents. The card reader shall be the HID MultiCLASS RP-40, or approved equal.

4. Furnish combination card reader-keypad units in the required quantities as indicated in the Contract Documents. The card reader-keypad shall be the HID MultiCLASS RPK-40, or approved equal.

5. Furnish keypad units in the required quantities as indicated in the Contract Documents. The keypad shall be the Stainless Steel K1 Series K1-26S as manufactured by Essex Electronics Incorporated, or approved equal.

6. Furnish power supplies as required and wall plate for each card reader and card reader-keypad unit.

7. Furnish all card readers and card reader-keypad units with required back boxes/plates. The back box enclosure shall be BT-HID-1001 as manufactured by Boyce Technologies or approved equal.

8. For outdoor installation, weather shields shall be provided.

L. Power supply/chargers for access control equipments

1. The unit shall be a UL listed power supply for fire and access control applications.

2. It shall be switch selectable to provide either 12 VDC or 24 VDC power limited output. The output shall be filtered and electronically regulated.

3. It shall be capable of providing 6 amps continuous supply current.

4. It shall be equipped with a built-in charger.

5. It shall be equipped with relay contacts for AC fail, Low battery supervision and battery presence.

6. It shall provide short circuit and thermal overload protection.

7. It shall provide continuous monitoring of internal system operation and battery charging system.

8. It shall provide reverse polarity protection and current draw in standby mode: < 60 ma.

9. Equip the unit with batteries to provide at least two (2) hours of back-up power. Submit ampere-hour calculations.

10. The unit shall be ALTRONIX AL600ULX or approved equal.

M. Power distribution module for access control equipment

1. The unit shall be UL listed for fire and access control applications.

2. It shall be switch selectable to provide either 12 VDC or 24 VDC power limited continuous output.

3. Relay controlled output is individually selectable for the following input options.

   a. Dry contact

   b. Open collector

   c. Voltage

4. The unit shall be ALTRONIX PD8UL or approved equal.

N. Outdoor Motion Detection Sensors

1. Outdoor motion detectors shall use dual technologies, passive infrared and microwave sensors and shall also be configured so that both technologies must detect an intruder before an alarm is generated.

a. Microwave Sensor: The microwave sensor shall use the "Doppler" principle of transmitting a field of microwave energy into surveillance area so that an intruder's motion disturbs the field, causing the reflected signal to change. The microwave sensor portion shall contain two receiving channels and use the "Stereo Doppler" technique, whereby the two received signals shall be compared to determine whether motion is moving toward or away from the sensor. An intruder moving a short distance (dependent on the sensitivity setting) in one direction shall cause an alarm; however, incidental vibration or fluctuating movement of trees, bushes, swinging signs, etc. shall be rejected by the sensor's circuitry. The 10-position digital Sensitivity Control Switch shall adjust the microwave sensor detection sensitivity in 4" (10 cm) increments

2. Passive Infrared Sensor: The passive infrared sensor portion shall use a dual element pyro-electric detector. The dual elements shall sense infrared energy, and the voltage output of the dual elements shall be of opposite polarity and combined into a single output. An intruder crossing the sensor field of view will be detected by causing a large voltage swing, first in one polarity and then in the other. However, large area changes in background infrared radiation shall result in a signal of minimum voltage amplitude (and no detection), with the opposite outputs for the dual element detector canceling each other. The Sensitivity Control Switch shall adjust the passive infrared detection sensitivity. Detection sensitivity shall be adjustable, enabling the selection of distance an intruder is required to move in one direction before causing an alarm.

3. Sensor shall have an adaptive signal processing for extreme environmental conditions.

4. Sensor shall be configured with enhanced immunity to fast moving targets

5. Circuit supervision shall cause a lock-in alarm condition with failure of a major component.

6. Multiple sensors shall be usable in the same area without mutual interference.

7. Sensor shall be equipped with Walk-Test and Environmental Caution Indicator lights with internal disable switch.

8. Specifications:

a.	Power:	8.5-20 VDC, 12 VDC Nominal
b.	Current:	150mA @ 12 VDC (LED's Off)
c.	Temperature:	-30 to 130 degrees F (-34 to 54 degrees C)
d.	Humidity:	0 to 100% Relative Humidity
e.	Relay Contact Rating:	0.1A, 50V
f.	Microwave Frequency Range:	10,525 MHz USA

g. The unit shall be equipped with a general mounting kit

9. For the doorways and at the security gates the unit shall be the PIRAMID LT Narrow Angle SDI-76XL-DIR-LT for the doorways and at the security gates as shown on the Contract Drawings and as manufactured by Protect, Inc, or approved equal.

10. For the motion detectors installed on the abutment locations the unit shall be the PIRAMID LT Wide Angle SDI-76XL2 as shown on the Contract Drawings and as manufactured by Protect, Inc, or approved equal.

11. For the motion detectors installed on the bridge structure, the unit shall PIRAMID LT Wide Angle SDI-77XL2 as shown on the Contract Drawings and as manufactured by Protect, Inc, or approved equal.

O. DIN rail mounted circuit breaker

1. The unit shall be UL listed.

2. The unit shall be sized to meet the power requirements.

3. The unit shall be ABB Group S201-CXX or approved equal.

P. Mortise Door Locks

1. For Mortise Door Locks manufacturers, products, and specifications, refer to Division 8 – 08715 Finish Hardware.

Q. Door Crash Bars

1. For Crash Bars manufacturers, products, and specifications, refer to Division 8 – 08715 Finish Hardware.

R. Swinging Gate Lock- Medium Security Automatic Deadlocking Electromechanical Chain Link Fence Gate Lock.

1. Furnish and install swinging gate lock at the security gate as indicated in the Contract Drawings.

2. General

a. The medium-duty electromechanical lock shall be furnished and installed for remote controlled electrical and manual key unlocking of a chain link fence gate. Deadlocking is automatic when the gate is closed manually. Electrical actuation is via a 24VDC solenoid and manual unlocking is by a standard mortise key cylinder supplied by either the factory or the user (e.g. master keyed to an existing system). The swinging gate lock can provide the convenience of remote controlled unlocking for a range of medium security gate locking applications from industrial and institutional enclosures to residential sites. It complements controlled access systems e.g. card reader and touch pad actuators) where a low voltage/power lock is a requisite.

3. Specifications

a. Size: approx. 14" x 4.375"

b. Manual key operation by standard mortise cylinder.

c. Current: 1.4Amp

d. Voltage: 24 VDC

4. Swinging Gate Lock- Medium Security Automatic Deadlocking Electromechanical Chain Link Fence Gate Lock shall be the 8030 series by RR brink locking systems, Inc..

S. Door status contact

1. Furnish and install Door Switch at all doors as indicated on the contract drawing.

2. General

   a. The switch shall be a reed switch with matching actuating magnet. Contractor may select switch with internal E.O.L. resistor feature if compatible with CSS equipment. Switch shall be UL rated.

3. Specifications

   a. Capacity: .25A @30VAC/DC (check with Lenel)

   b. Type: SPDT

   c. Actuating Gap Distance: 0.2" to 0.6"

4. The door status switches shall be model 2707A by Sentrol, Portland, Oregon, 97223, (800) 547-2556 or approved equal.

T. Horn and Strobe

1. Furnish and install Horn and strobe at all the doors accessible from outside as indicated on contract drawings.

2. Horn and strobe shall provide visual and audible alarms incase door is accessed.

3. Specifications:

   a. Type: Outdoor

   b. Current : 20mA

   c. Voltage: 24vdc

   d. Temperature: 31 to 150degrees F (-35 to 66 degrees C0

   e. Humidity: 95 % Relative Humidity at 85F

   f. Sound Level Output: 90dBA at 10ft.

   g. Mounting: Outdoor surface mount

   h. Strobe flash rate: 1 flash per second.

The Horn and Strobe shall be model 868STR-AQ by AdaptaBeacon Edward Signaling

2.03 CONSTRUCTION FEATURES

A. Not applicable

2.04 ACCESSORIES

A. As recommended by the ACS equipment manufacturer required for full operation and maintenance service s.

2.05 FABRICATION / or MIXES

A. Not applicable

2.06 SHOP FINISHING

A. Not applicable

2.07 SHOP TESTING

A. The contractor shall provide the Engineer with complete system shop test results and manufacturer certification that the system meets all performance specifications.

B. The system shop test shall include but not be limited to the following:

1. Schematic drawings showing interconnection and types of simulation equipment employed
2. Test design specifications
3. Test procedure specifications
4. Test item transmittal reports
5. Test logs
6. Test incident reports
7. Test summary reports
8. Test input data and test output data (computer printouts of data dumps)
9. The level of detail of the test plan shall meet the requirements of the Engineer. Said submittal shall be approved by the Engineer prior to the Contractor making written request for Factory Inspection and Test. Test requirements include preparation of a final report indicating compliance with all test parameters and including copies of all written test documentation

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that all equipment is available and ready for installation. Replace any damaged items.

B. Verify that required power facilities are available in proper location.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the system.

B. The entity manufacturing the system shall provide on-site technical supervision and assistance during installation and interconnection of the system equipment installed by the Contractor. Said supervision is to ensure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

C. After the system equipment has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Specification, the Contractor will be notified in writing, and shall be required to replace the equipment at its own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

3.03 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions. Transition from existing system shall not disrupt access control system control functions at any time or in any manner, and shall be approved in advance by the Authority.

B. Do not install equipment until power facilities are available where required.

C. Maintain area free of dirt and dust during and after installation of products, all at no additional cost to the Authority.

D. Connect equipment as shown on the approved shop drawings.

E. The Contractor shall enter all computer programs and data files in the related computers including all control programs, and initial approved parameters and settings.

F. The Contractor shall prepare and submit, for the approval of the Engineer, a detailed schedule of work to be performed in conjunction with the acquiring of data, entering of data to the system database and associated site specific software configuration data. Said schedule shall meet the requirements of the Engineer with regard to the level of detail. This schedule shall include, but not be limited to, the following items:

1. Data Requirements
2. Operators & privileges, including master passwords
3. Site Specific Configuration
4. Proximity Cardholders database file structure
5. Proximity Cardholders database file data entry
6. Proximity Cardholders security codes
7. Data Entry
8. Data Entry listing & verification
9. Preparation of Graphic Maps
10. Manual Submittals
11. Training Curriculum and Schedule

G. The Contractor shall maintain duplicate machine-readable copies of all data files and application software for reload use in the event the need for system rebuild. One copy of each shall be delivered to the Authority prior to training session, and one copy of each shall be archived in the Contractor's local software vault. Said copies shall be updated on a monthly basis with clearly defined, dated and consistently managed version control for the duration of the warranty period.

H. Remove all existing wire, conduit and cables for equipment being removed.

I. Contractor shall provide end to end testing of the ACS system and its subsystems in coordination with the Engineer.

3.04 FIELD QUALITY CONTROL

A. General

1. After delivery, a field inspection of the System equipment will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment had been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the System will be installed by the Contractor as required.

2. After installation, the System shall be tested to show compliance with this Section. The Contractor shall submit the proposed field testing procedure to the Engineer for approval two weeks prior to the proposed start of test. Said testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed by the Contractor without additional cost to the Authority.

3. After satisfactory completion of field testing, a 30-day operational test shall commence. The Contractor shall correct any malfunctions as they occur, said malfunctions including, but not being limited to, equipment failure or failure of the System to comply with this Section. After the Contractor corrects a malfunction, at no cost to the Authority, the 30-day test shall restart, at day one, and shall continue until the results are satisfactory with the written approval of the Engineer.

4. Acceptance Test Reports: Following the completion of each test period, the Contractor shall prepare and deliver a Final Test Report that describes the results of the test period and the next steps to be taken. No test phase shall be considered complete, nor may the Contractor proceed to the next phase of the project until the Authority has approved, in writing, the Contractor's test report for the previous phase. The report shall contain, but not be limited to:

   a. Summary of the test period results including a statistical analysis of test results.

   b. Descriptive narrative of individual test objective(s).

   c. Data dictionary of test database.

   d. System status prior to testing and after testing.

   e. Expected test results.

   f. Actual test results.

   g. Exception condition report (when applicable).

   h. Explanation of exception conditions and Contractor corrections.

   i. Before and after database listings.

   j. All applicable screen printouts, reports, interim processing dumps and other audit trail physical evidence to validate the test activity for each iteration of the test conducted.

5. The Contractor shall completely check, test, and calibrate all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operation required.

6. The Contractor shall conduct a validation demonstration witnessed by the Engineer, which shall consist of, but not be limited to:

   a. Running each specified report.

   b. Display and demonstrate each data entry template to show site specific customizing capability. Demonstrate parameter changes.

   c. Execute menu tree.

   d. Display graphics, demonstrate update.

   e. Execute commands in English text and graphic mode.

   f. Demonstrate freeform address assignments and commands.

   g. Demonstrate all specified diagnostics.

   h. Demonstrate system performance.

   i. Demonstrate scan, update, and alarm responsiveness.

   j. Demonstrate and verify all access control system control functions in operation for each access control system equipment item controlled and each point monitored.

7. The Contractor shall submit a test report detailing compliance with the requirements of item E and item F above.

B. Field Tests

1. Pre-Acceptance Testing:

   a. The Contractor shall develop and implement a comprehensive testing program that includes test activity conducted internally by the Contractor during the system development period of the project, as well as formal acceptance testing conducted by the Contractor in the presence of the Authority. During the system development period, and prior to the Contractor's submission of the ACS for acceptance testing, the Contractor shall test the software and hardware components individually and in an integrated fashion to ensure that they perform according to Specifications as set forth herein, and that they do not produce errors, exception conditions, performance bottlenecks, etc. While this testing period shall, in general, be conducted by the Contractor without regular monitoring by the Authority, the Authority shall have the right to review and inspect the output of this test process at any time. Test milestones for this pre-acceptance testing shall be reflected in the Project Plan and Schedule and shall be documented in the Contractor's regularly issued project status report. All unit, module, subsystem and system testing shall produce auditable documentation which shall be maintained and delivered to the Authority upon request and/or system acceptance.

b. Wherever possible, the Contractor shall make use of automated tools for software testing. These tools may include, but are not limited to: code generators, code testers, data dictionaries, data element cross references, execution analyzers/tracers, and test data/file generators, test script automatons, etc. Tests conducted during the development period shall follow the standard industry procedure of unit and integration testing, in which blocks of test code are combined at progressively higher levels of integration. Tests shall consist of, but shall not be limited to: full range testing and validation of data, adding/deleting/changing records within all databases/files, the exercise of error and exception conditions, the exercise of numerous cycles of processing (daily, monthly, etc.), and stress testing to show proof that the ACS meet all performance criteria under peak loads as specified in the performance requirements. All test activity, including that conducted during system development and formal acceptance testing shall be conducted in accordance with the Contractor's standards and methodology and the Contractor's Quality Assurance Plan.

c. Upon completion of all pre-acceptance testing, the Contractor shall perform the full set of acceptance test cases to determine that all tests can be run without error. Only upon Contractor certification that the ACS has completed all pre-acceptance testing and has successfully run through the acceptance test set, shall the Contractor invite the Authority to participate in the formal acceptance testing process. The Authority will plan and schedule for its staff to participate in one (1) test session of each of the three (3) acceptance test milestones. Should it be necessary for the Contractor to reschedule or extend the test session beyond the scheduled duration, the Contractor shall bear all costs incurred by the Authority (including, but not limited to, Authority staff time, travel and other costs) expressly due to Contractor incurred delays.

2. Acceptance Testing:

a. The Contractor shall conduct a full program of acceptance testing, the purpose of which shall be to demonstrate to the Authority satisfaction that the ACS fulfills all of the Specifications as set forth herein and as shown in the Contract Drawings. Contrasted with pre-acceptance testing, acceptance testing shall involve the direct monitoring of the testing process by the Authority, and shall be conducted in three (3) separate and distinct test periods (factory, field, and operational testing), and shall be designed to exercise all components of the System individually and collectively as one integrated System. All test periods shall be conducted based on a formal Acceptance Test Plan submitted by the Contractor and approved by the Authority, which shall include test objectives, test scripts and cases, as well as anticipated results. When all tests for a period have been completed to the satisfaction of the Authority the Contractor shall prepare and deliver to the Authority an Acceptance Test Report for that period. Contents of the Acceptance Test Report are set forth in Article 1.06 F. of this Section. Only upon review and approval of the report by the Authority, shall the Authority accept that test and give permission to proceed to the next test.

b. The test plans and procedures provided by the Contractor shall insure that all of the ACS functional parameters and performance specifications are thoroughly tested. The Acceptance Test Plan shall be subject to the prior review and approval by the Authority. Any errors detected during any testing period shall be noted and corrected by the Contractor before proceeding to the next testing period.

3.05 ADJUSTING (or ADJUSTING AND CLEANING)

A. Not applicable

3.06 PROTECTING

A. Not Applicable

END OF SECTION

SECTION 13705

[ACCESS CONTROL SYSTEM]

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Bill of Materials as per the approved catalog cuts
2. System Block Diagram
3. Detailed System Wiring Diagrams, indicating all field terminal block numbers
4. Point Schedules
5. Device matrices
6. Complete, comprehensive, single-line diagrams, including all equipment, devices and cabling completely identified.
7. All "red line" drawings.
8. Wire, cable, conduit and connectors
9. Enclosure and device installation details
10. Terminal block connection diagrams for all system components.
11. Detail drawings, which clearly illustrate the typical mounting configuration of each major equipment item. While some drawing details may be "typical," the drawings shall illustrate the installation detail of each unique application.
12. Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
13. Fabrication shop drawings for all custom equipment
14. Elevation drawings showing all CCTV related equipment locations and dimensions. These drawings shall also include wiring and power requirements.
15. Engineering calculations concerning wire sizes to ensure that the proper cable sizes have been provided.
16. Equipment Schedules and or details which define all of the equipment used within the System.

B. Catalog Cuts

1. HID multiCLASS RPK-40 Card Reader with Keypad
2. HID multiCLASS RP-40 Card Reader
3. Essex Electronics K1-26S Enclosure Keypad

4. BT-HID-1001 Card Reader Box Enclosure
5. Lenel-3300 Intelligent System Controller
6. Lenel-1320 Series 2 Dual Reader Interface Module
7. Lenel-1100 Series 2 Input Control Module
8. Lenel-1200 Series 2 Output Control Module
9. Lenel LNL-CTX-6 Access Control Panels
10. IBM 3650 M3 Lenel OnGuard Regional Server Hardware
11. IBM 3650 M3 Lenel OnGuard Dedicated Redundant Server Hardware
12. IBM 3650 M3 Lenel OnGuard Dedicated Redundant Server Hardware
13. SPECIFY RACK-LAPTOP and KVM switch or Console Kit and KVM Switch?
14. Altronix AL600ULX ACS Power Supply
15. GE Security 5415A Tamper Switch
16. SECURITRON M82B 1,800lbs. Magnetic Door Lock
17. SECURITRON M32-SS 300lbs. Access Control Panel Magnetic Enclosure Lock
18. SECURITRON MCL 200lbs. Field Equipment Panels/Field Fiber Distribution Box Magnetic Enclosure Lock
19. GE Sentrol 2707AD Magnetic Contacts
20. Protech PIRAMID LT Narrow Angle SDI-76XL-DIR-LT Motion Detector
21. Protech PIRAMID LT Wide Angle SDI-76XL2 Motion Detector
22. Protech PIRAMID LT Wide Angle SDI-77XL2 Motion Detector
23. Traka Key Management System

C. Samples

1. Motion Detector sample and demonstration

D. Product Data

1. Not applicable

E. Certificates

1. Lenel Certification if applicable

F. Manufacturer Test Reports

1. To be provide by direction of the Engineer

G. Construction and Installation Procedures

1. Construction plan shall be provided to the Engineer for review and approval

H. Calculations

1. To be provided as recommended by the equipment/ system manufacturer

I. Manuals, Warranties/Guarantees

1. Complete sets of system manuals shall be submitted explaining all system capabilities and options, including but not limited to the installation, set-up, operation and maintenance of all equipment furnished as Work of this Section. Submittal shall be furnished in both hardcopy and digital format.

J. Schedules

1. Within fifteen (15) calendar days after receipt by the Contractor of the acceptance of his Proposal, the Contractor shall submit to the Engineer a Project Plan and Schedule.

2. The Project Plan and Schedule shall include Gantt charts, PERT charts or other tabular representations of the activities and tasks of the project as appropriate to show when tasks occur, when resources are required and what dependencies exist. The Project Plan and Schedule shall be of sufficient detail and clarity so that the Work can be controlled and the Authority can monitor progress during the life of the project. The charts shall indicate a logical sequence of Work and identify all dependencies, resources (i.e., management, technical and administrative staff), material and equipment, required for completion of the Work. The degree of detail shall be sufficient to identify at a minimum:

   a. Major Contract phases and the identification of milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.

   b. Project activities with associated tasks and sub-tasks.

   c. Interfaces and dependencies with preceding, concurrent and succeeding Work effort.

   d. Resources needed and assignments down to the task level (for staff, material and equipment).

3. In addition to the above, the Project Plan and Schedule shall contain any changes, updates or new information related to the Contractor's project organization, methodologies and standards, facilities, Quality Assurance Program or any other requirement, deliverable or feature related to the performance of the ACS, different from the information which the Contractor included in their Proposal.

4. Within ten (10) calendar days of receipt of the initial Project Plan and Schedule, the Engineer will formally comment on its content. The Contractor shall make appropriate changes to the Project Plan and Schedule and resubmit it for Engineer review and approval. Thereafter, the schedule shall be updated in writing at 30-day intervals.

K. Qualifications

1. Furnish the name and address of the System Installer and Integrator.

2. Submit a list of a minimum of three installations, at least one of which shall be located in the United States, which shall have included work, comparable in type, size and complexity. Said installations shall be in satisfactory operation for the last three consecutive years, at minimum. Furnish references and current contact information for each project.

3. Furnish references and current contact information for each project.

4. Furnish the resumes of all key project management, integration and installation personnel.

5. Furnish certifications of training of key personnel in the installation and maintenance of the major equipment manufacturers.

6. Approval of qualification information is required prior to transmittal of any further submittals of this Section.

L. Quality Assurance-Quality Control

1. Submit comprehensive Acceptance Test Plans that describe all the activities and tasks associated with testing of the System in accordance with the requirements of this Section. The test plan shall include a comprehensive description of the Factory Acceptance, Final Acceptance and Operational Acceptance testing to be performed.

2. Furnish the following:

   a. Preliminary Test Reports

   b. Factory Acceptance Test Plan

   c. Factory Acceptance Test Results

   d. Final Acceptance Test Plan

   e. Final Acceptance Test Results

   f. Operational Acceptance Test Plan

   g. Operational Acceptance Test Results

3. Upon completion of 30 day Operational Acceptance Testing submit:

   a. As-Built Drawings and Shop Drawings, which reflect actual locations and actual wiring details of system equipment and all revisions to the Work of this Section. One set shall be printed on reproducible mylar

   b. Hardware Documentation shall be provided in hard copy and digital format.

      (1) A hard copy back-up of all database and configuration settings.

      (2) Electronic backup of all software, database and configuration settings to allow for system recovery and restoration.

4. A detailed outline of the training information as described in this Section.

5. Additional items which shall be included as part of the required submittals are test and certification reports for all twisted pair Ethernet and fiber optic cables installed as Work of this Section.

M. Record Documents

1. Not applicable

N. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list.

O. Inspection Reports

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field- assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.

2. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

3. Pre-testing: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video surveillance equipment for acceptance and operational testing as follows:

   a. Prepare equipment list described in Part 1 "Submittals" Article.

   b. Verify operation of auto-iris lenses.

   c. Set and name all preset positions; consult Department's personnel.

   d. Connect and verify responses to alarms.

   e. Verify operation of control-station equipment.

   f. Submit complete reports on Inspections and Pre-testing results.

P. Contact Information

1. Not applicable

Q. Training

1. Training of the Port Authority's designated operators shall be provided by the Contractor as follows:

   a. All training shall be by the Contractor at the location specified by the Engineer and shall utilize specified manuals and as-built documentation. All training shall be completed 14 calendar days prior to commencement of the 30 day operational test.

   b. Operator training shall include a simulation of actual site conditions and shall be provided for two groups of 15 students per course. Each group shall be trained for two eight hour instructional classes to be held on two separate days. The operational training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

      (1) Sequence of Operation Review.

      (2) Sign On - Off

      (3) Selection of all displays and reports.

      (4) Commanding of points, English and graphic Mode.

      (5) Modifying English text.

      (6) Selection of all access control functions.

      (7) Review of all topics presented in the Operator's Manual.

      The Contractor shall provide thirty Operator's Manuals for persons attending these instructional classes and shall provide fifteen additional Operator's Manuals for the Authority's use.

c. Supervisor training shall include, in addition to subjects addressed in the operator training classes, training for two groups of six Authority supervisors. Each group shall be trained for two eight hour instructional classes to be held on two separate days. The supervisor training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

(1) Communications System instruction.

(2) Use of portable operator terminal

(3) Program upload/download/modification.

(4) Password assignment/modification.

(5) Operator assignment/modification.

(6) Operator authority/assignment/modification.

(7) Point disable/enable.

(8) Terminal and data segregation/modification.

(9) Review of all topics presented in the Supervisor's Manual

The Contractor shall provide twelve Supervisor's Manuals for persons attending these instructional classes and shall provide six additional Supervisor's Manuals for the Authority's use.

d. System Administrator and maintenance training shall include, in addition to subjects addressed in the operator training and supervisor training sessions, training for two groups of six students per course. Each group shall be trained for four eight hour instructional classes to be held on four separate days. The system administrator and maintenance training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass.

(1) Software review, sequence of operation and flowcharts.

(2) Modification of control programs and databases.

(3) Add/Delete/Modify data points

(4) Use of diagnostics

(5) System maintenance procedures.

(6) Review of initialization.

(7) Upload/download and off-line archiving of all systems software.

(8) Review of all topics presented in the System Administrator's Manual.

(9) The Contractor shall provide twelve System Administrator's Manuals for persons attending these instructional classes and shall provide six additional System Administrator's Manuals for the Authority's use

e. The Contractor shall videotape each type of instructional class and shall provide twelve copies of each instructional class on videocassette for the Authority's use. The Contractor shall also provide videotaped instruction for the operation of each and every item of equipment supplied.

2. Training Report: Upon completion of all training programs, the Contractor shall prepare and deliver a training report which shall summarize the results of the full training program, including the number of training sessions conducted by type and date, the attendance sheets and the course evaluation forms for each training session.

R. Closeout Submittals

1. Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section.

S. Information

1. Not applicable

T. Permits

1. Not applicable

U. Maintenance Agreements

1. Contractor shall submit a proposed maintenance agreement.

V. Sustainability Submittals

1. Not applicable

END OF APPENDIX "A"

DIVISION 13

SECTION 13710

VIDEO SURVEILLANCE SYSTEM – CAMERAS

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4. Minimum Network and Data Requirements.

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DIVISION 15

SECTION 15310

SPRINKLER FIRE PROTECTION - PIPING AND APPURTENANCES

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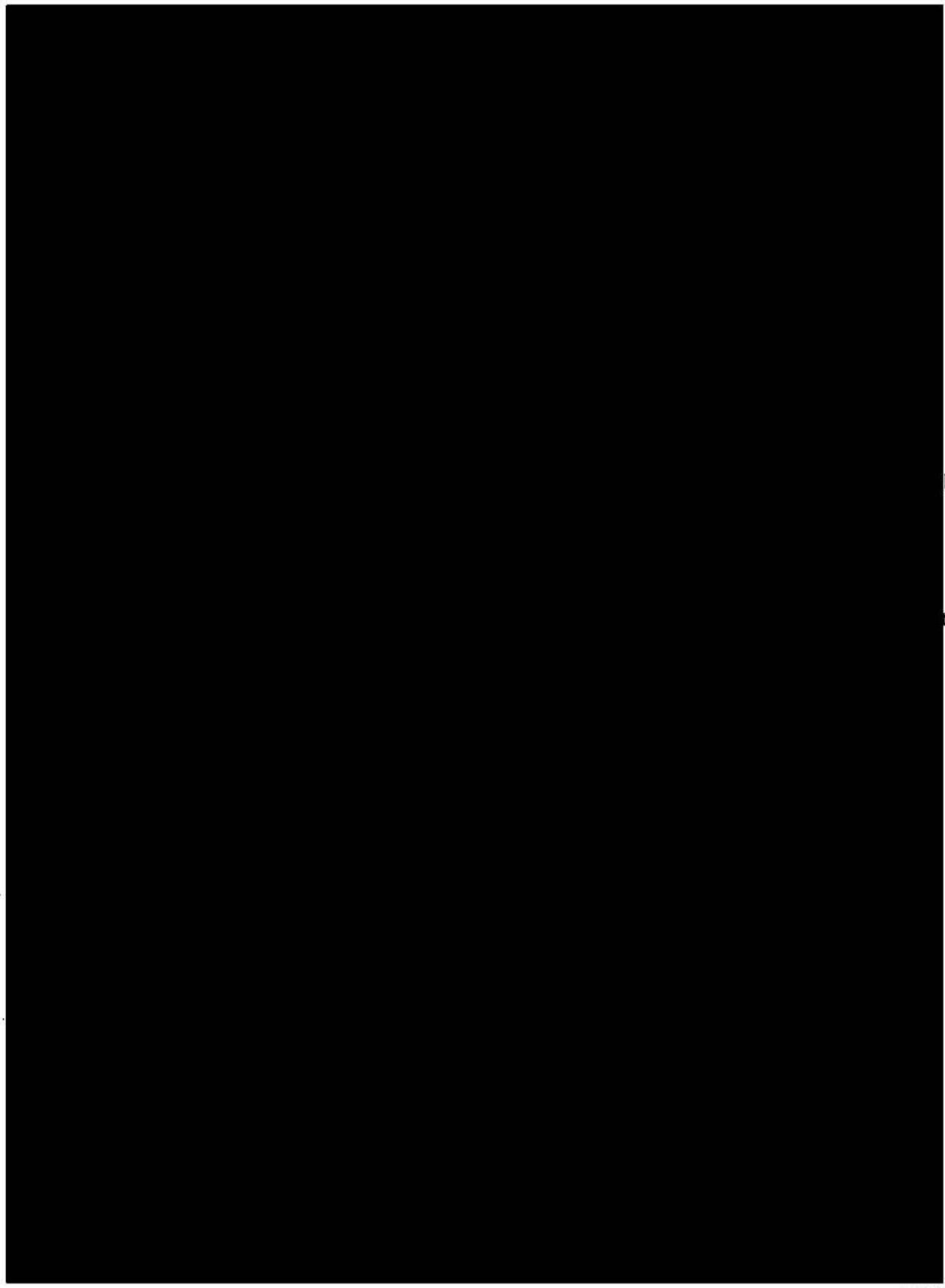

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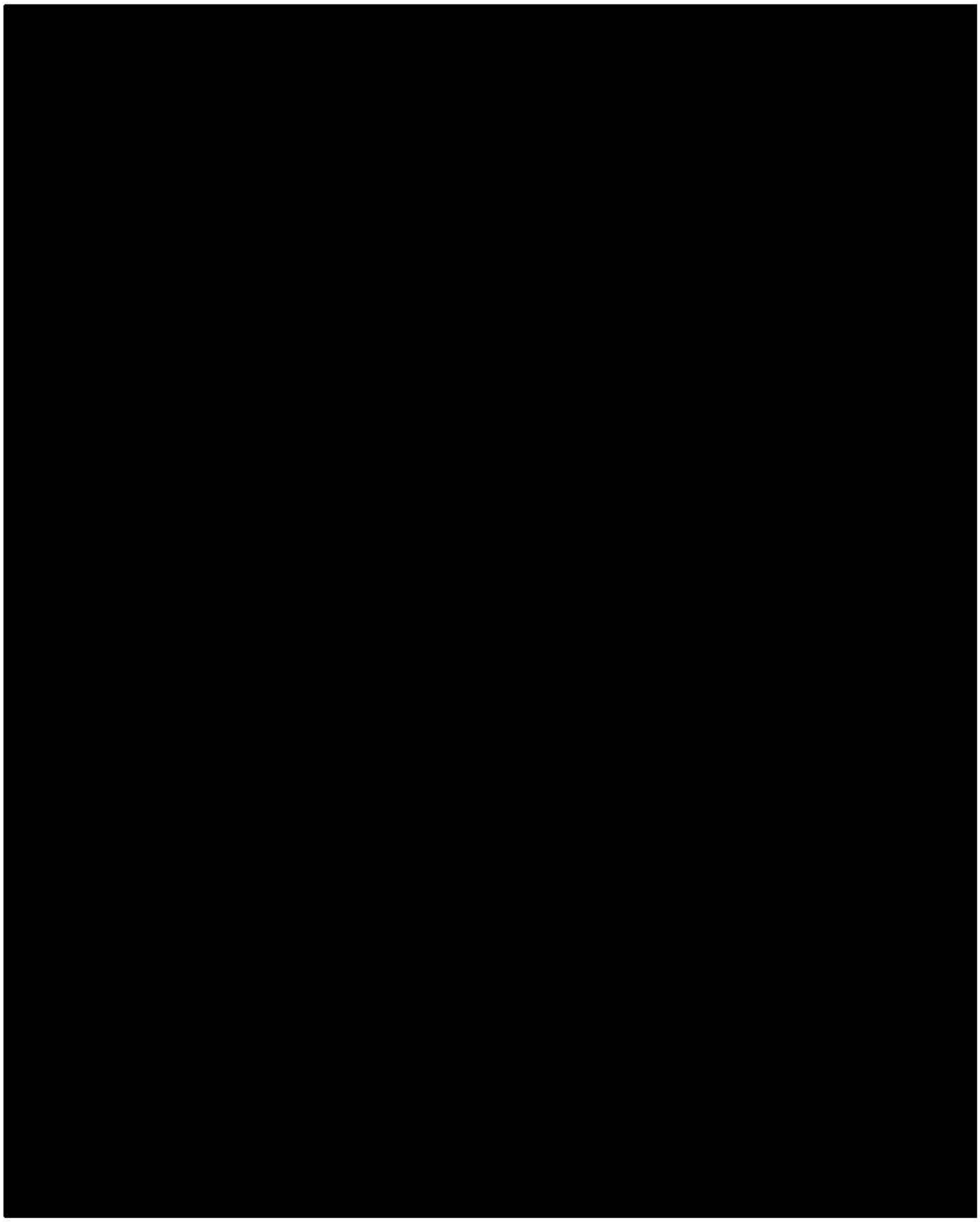

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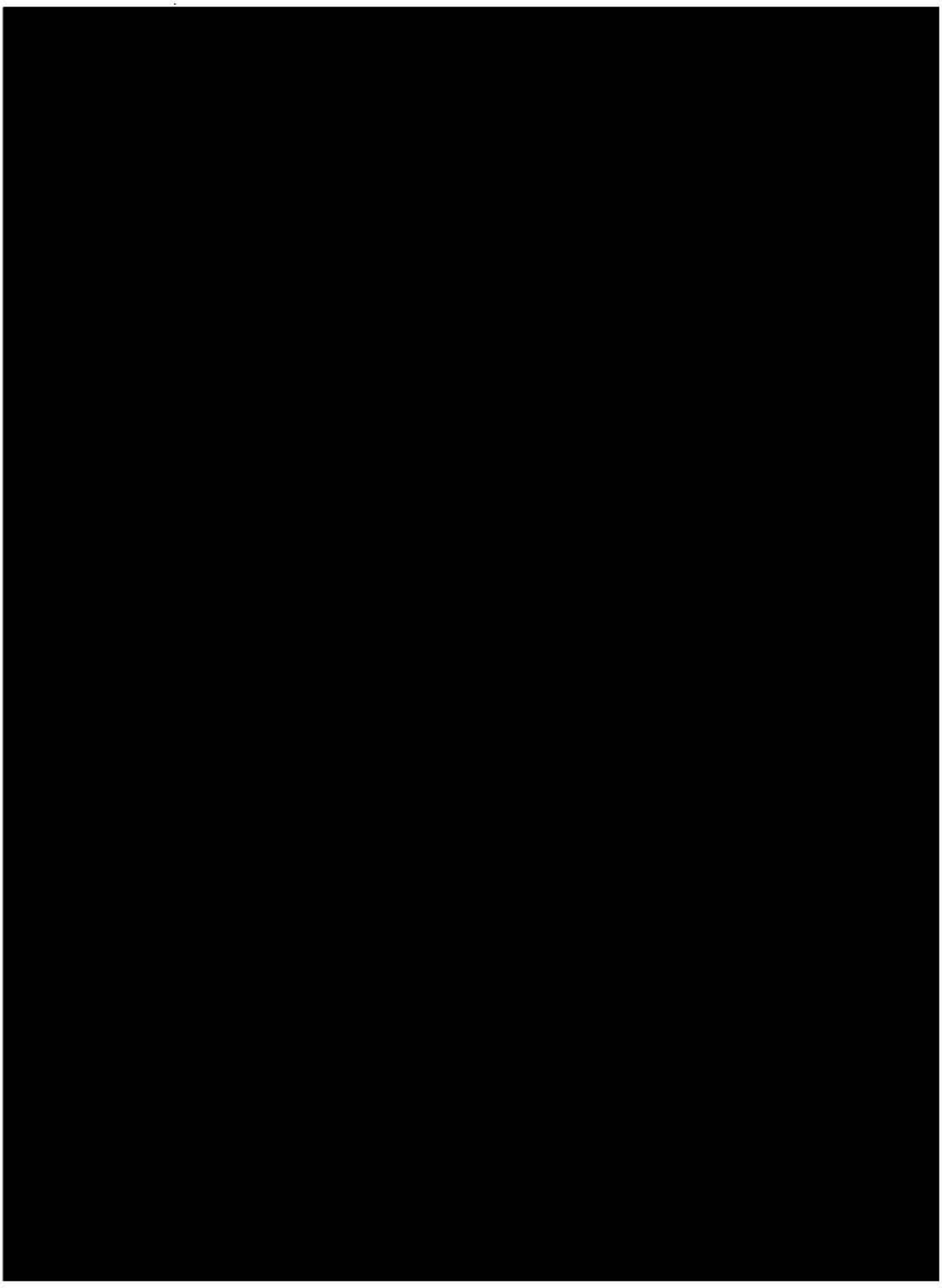

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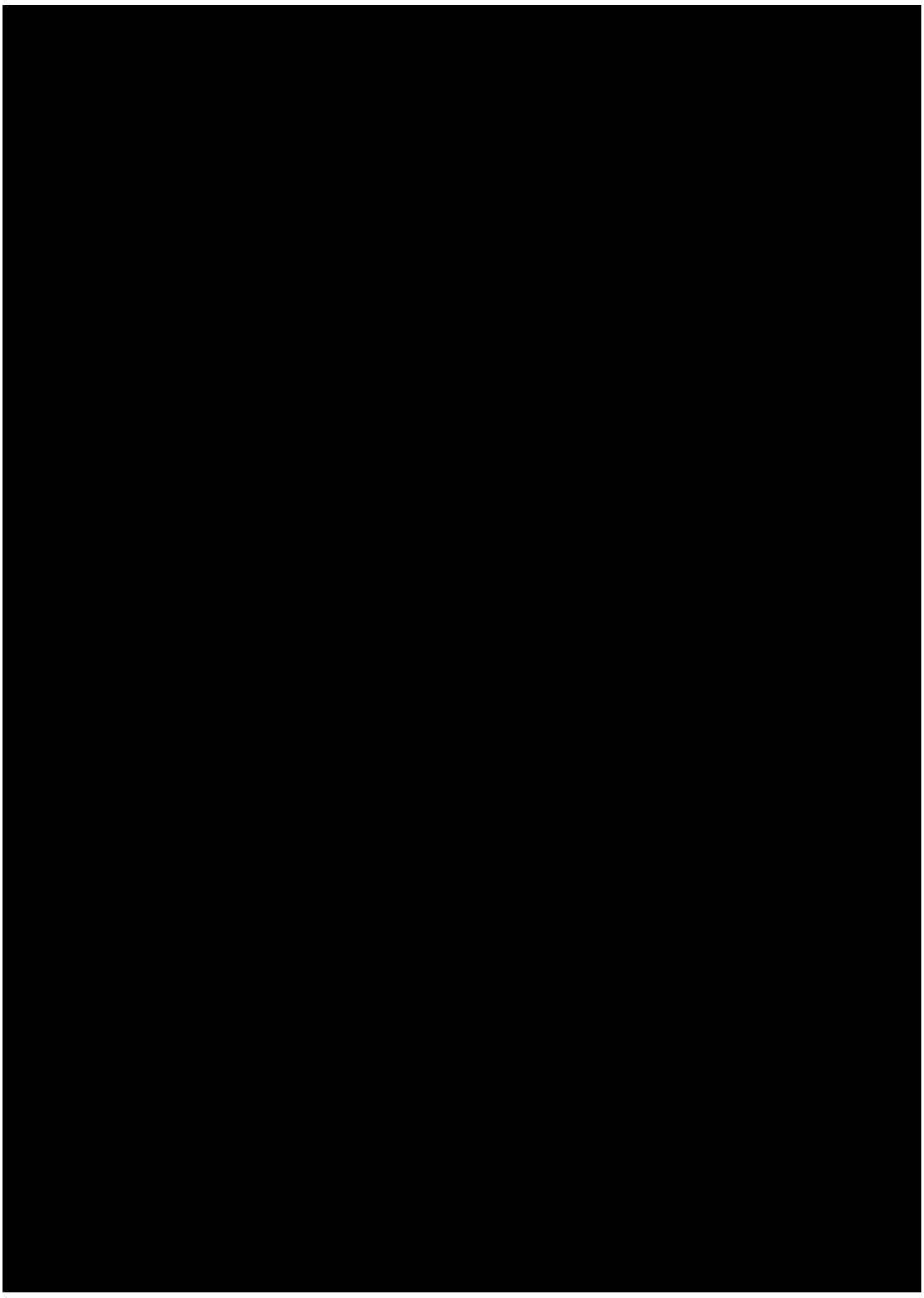

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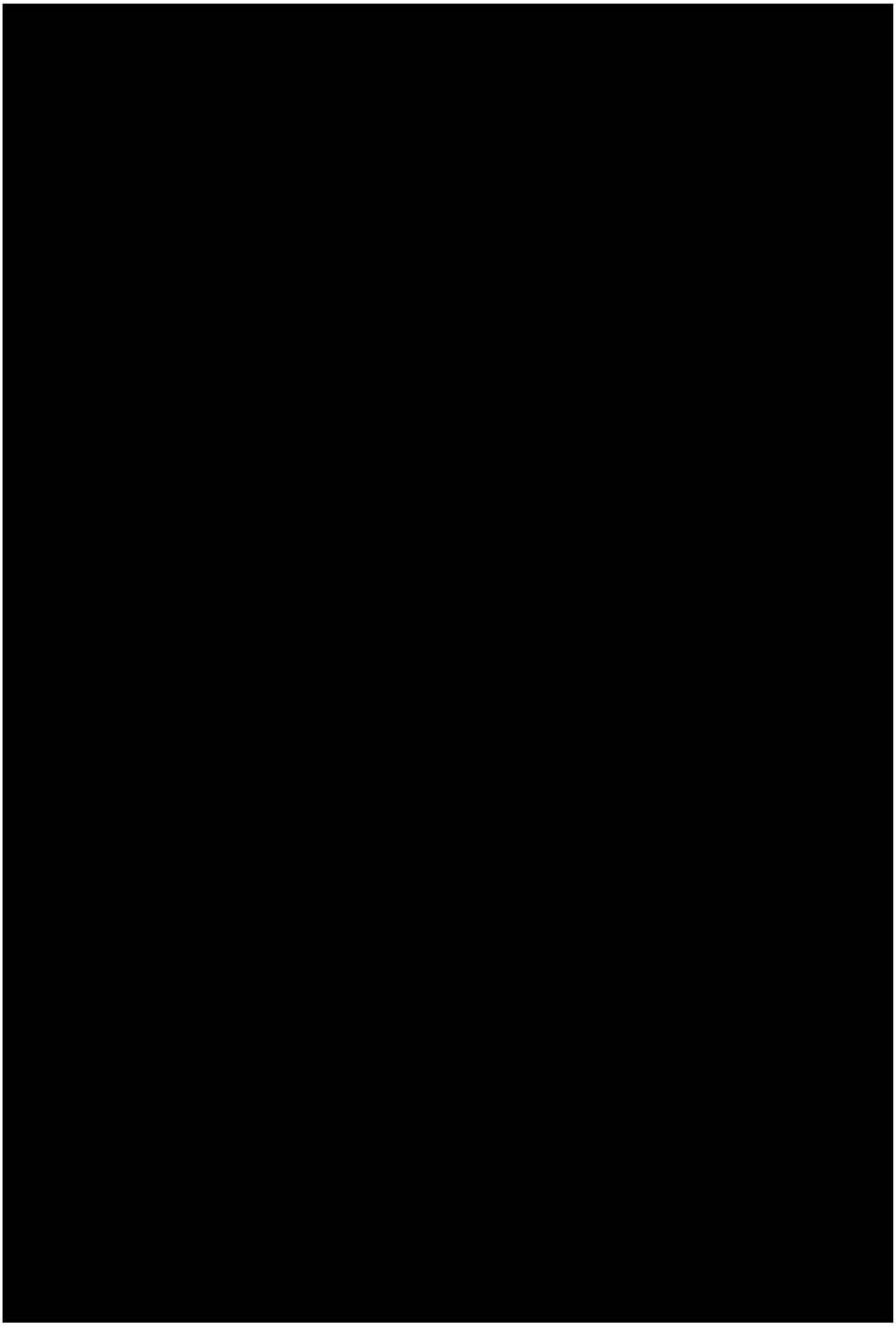

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SECTION 15385

STANDPIPE EXPANSION JOINTS AND BALL JOINTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data / Catalog Cuts

1. Piping Expansion Joints

   a. Product outlines and dimensions of selected models including, at a minimum, required clearances.

   b. Components, materials, weights (shipping, installed and operating) and assembly details.

   c. Rated capacity and performance data.

   d. Catalog cuts.

   e. Installation procedures.

   f. Shop test results.

   g. Manufacturer's certificate for cycle test reports.

   h. Performance requirements and design criteria for each anchor and alignment guide, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Design Calculations

1. Calculations of requirements for thermal expansion of piping systems and selection and design of expansion joints.

C. Operation and Maintenance Manuals

1. Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists and test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15410

PLUMBING PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for domestic water service piping, storm and sanitary sewer piping, and appurtenances.

B. Domestic water service and storm and sanitary sewers installed under this Section end at the building line unless otherwise shown on the Contract Drawings. The continuation of the domestic water service and storm and sanitary sewers is specified under Division 2 of the Specifications. Types of material and installation of the piping under this Section shall be compatible with types of material and installation specified under Division 2.

C. Trenching and backfilling required in conjunction with underground piping furnished under this Section shall be as specified in applicable Sections of Division 2 and shall be included as Work under this Section.

1:02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

New York City Building Code

New Jersey Uniform Construction Code

Municipal Water Company

American National Standards Institute (ANSI)

American Society for Testing and Materials (ASTM)

American Society of Mechanical Engineers (ASME)

Cast Iron Soil Pipe Institute (CISPI)

American Water Works Association (AWWA)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Plumbing piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

Refer to Appendix A.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Unless otherwise shown on the Contract Drawings, provide pipe (and tube), fittings, and flanges in accordance with the "Pipe, Fittings, and Flanges Schedule" specified below, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of piping systems.

B. Nipples shall be extra-heavy shoulder type. No close nipples shall be used. All nipples shall have designation mark of the manufacturer and shall conform to ASTM pipe specifications for system served.

C. Gaskets for flanges shall be 1/16-inch thick (after compression) rubber or neoprene, full-faced, and punched bolt holes.

D. Unions shall be malleable iron, threaded, conforming to ANSI B16.39.

Pipe, Fittings and Flanges Schedule

Systems	Pipe	Fitting and Flanges
Storm & Sanitary Drainage & Vent (underground)	Cast Iron, ASTM A 74, Service Weight Hub & Spigot Type	Cast Iron, ASTM A 74, Service Weight Hub & Spigot Type; caulked or compression type joints
Storm & Sanitary Drainage & Vent (above ground and underground)	Cast Iron, CISPI-301, ASTM A888, Service Weight Hubless Type	Cast Iron, CISPI-301, ASTM A888, Service Weight, Hubless Type
Storm & Sanitary Pump Discharge	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Malleable Iron, ANSI B16.3, 150 lb. Class, Threaded
Sanitary Indirect Drainage	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Cast Iron (Drainage), ANSI B16.12, 125 lb. Class, Threaded
Domestic Water	Copper Tubing, ASTM B 88, Type L, Drawn, Nominal Wall	Cast Bronze, ANSI B16.18, Same Wall as Tube, Solder Joints
Domestic Water at Meter Assembly (3 inches and larger)	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Cast Iron, ANSI B16.1, 125 lb. Class, Flanged (Companion)

2.02 VALVES

A. General

1. Provide types of valves as and where shown on the Contract Drawings.
2. All gate and globe valves shall be the products of one manufacturer.
3. Valves shall be of one of the following manufacturers, or approved equal:
   a. Stockham Valves and Fittings
   b. Crane Co.
   c. Walworth Co.
   d. NIBCO Inc.

B. Gate Valves

1. For piping 2 inches and smaller: Class 125, bronze body, screw-in bonnet, rising stem, solid wedge, approved equal of Stockham fig. B-122 (threaded ends), or Fig B-109 (soldered ends).
2. For piping 2 1/2 inches and 3 inches
   a. Class 125, iron body, bolted bonnet, rising stem, solid wedge, bronze mounted, flanged ends, similar to Stockham Fig. G-623, or approved equal.
   b. Class 150, bronze body, screw-in bonnet, rising stem, solid wedge, threaded ends, similar to Stockham Fig. B-122, or approved equal.

3. For piping 4 inches and larger: Class 125, iron body, bolted bonnet, solid wedge, bronze mounted, OS&Y, flanged ends, similar to Stockham Fig. G-623, or approved equal.

C. Globe Valves

Class 150, bronze body, screw-in bonnet, rising stem, integral seat, renewable disc, approved equal of Stockham Fig. B-22 (threaded ends), or Fig. B-24 (soldered ends).

D. Drain Valves

Class 125, gate valve, bronze body, screw-in bonnet, non-rising stem, solid wedge, threaded ends on inlet side of valve and hose end thread with cap and chain on the outlet side, similar to NIBCO Fig. T-113-HC, or approved equal.

E. Check Valves

1. For pipe 2 inches and smaller: Class 125, bronze body, horizontal swing, renewable disc, approved equal of Stockham Fig. B-321 (threaded ends), or Fig. B-319 (soldered ends).

2. For piping 2 1/2 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, horizontal swing, renewable seat, flanged ends, similar to Stockham Fig. G-931, or approved equal.

3. Ball Valves

For piping 1 inch and smaller: Class 150, bronze body, full port, bronze trim, approved equal of Stockham Fig. S-216 BRRT (threaded ends) or Fig. S-216 BRRS (soldered ends).

2.03 ACCESSORIES

A. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of flow. Sets shall be provided in quantities sufficient to accommodate the requirements of 3.04 A of this Section.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2 1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A13.1.

c. Adhesive bands shall be W.H. Brady Co. "Quik-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high and valve number shall be 1/2-inch high, on two lines with service designation on the upper line, and valve number on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules.

d. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

e. Tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

B. Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors will be furnished and installed under other Sections.

2.04 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Hangers and supports shall include guides, anchors, stops, restraints, welded attachments, insulation shields, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hangers and supports.

C. Keep the different types of hangers to a minimum. Provide clevis type hangers for sizes 3 inches and above.

D. Suspend hangers from beam clamps, brackets, fish plates, inserts or other approved means. Furnish and install any additional miscellaneous steel supports between building framing members as may be required. The installation of "C" clamps on beams must include retaining straps to prevent separation of beam and clamp.

E. Copper plate all hangers that will be in direct contact with brass or copper tubing.

F. Support vertical piping with steel riser clamps. Additional intermediate support brackets, secured to the structure, shall be installed on piping utilizing gasket or coupling joints in accordance with the manufacturer's recommendations.

G. Trapeze type hangers of steel construction, with hold-down U-bolts, may be used for two or more pipes which have a uniform slope throughout.

H. Base hanger loads on weight of pipe supported, weight of insulation covering and weight of fluid being transported.

I. When loads between supports can be expected to cause a sag in the pipe in excess of 1/4 inch, reduce spacing as necessary to stay within such a limit.

J. Provide and install on all supporting rods, a forged steel turnbuckle with top and bottom lockouts having a vertical adjustment of 6 inches, minimum.

K. All pipe hangers, rods, supports, insulation shields, clamps, and other associated components shall be galvanized.

L. Do not hang piping from other piping and ductwork, except for small water branches in pipe enclosures behind toilet rooms or as approved by the Engineer.

M. Vertical pipes shall be supported on every floor and at intervals between floors so that no more than 10'-0" of pipe is unsupported.

N. Provide protection shields for all insulated piping at all points of support. Shields shall be 12 inches long, galvanized steel plate with a radius suitable for the required applications, including insulation.

O. Tabs in metal deck construction shall not be used to support pipe or equipment.

P. Provide pipe anchors where necessary to restrain forces due to thermal expansion and contraction of pipe.

Q. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

R. Provide pipe guides where necessary to confine movement along the centerline of the pipe due to thermal expansion and contraction between anchors. Guides shall be adequately designed and placed, generally between 20 to 30 feet on centers and an equal distance from the expansion loop.

S. Expansion anchors, self-drilling expansion shields, power driven studs and similar devices shall not be used, unless specifically approved by the Engineer.

T. Unless otherwise specifically approved, hanger rod size and spacing shall be within the following limits:

1. Steel Pipe

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	8 ft. o.c.	3/8"
1 1/4" to 2"	10 ft. o.c.	3/8"
2 1/2" to 3 1/2"	12 ft. o.c.	1/2"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8"	12 ft. o.c.	7/8"
10" and 12"	12 ft. o.c.	7/8"

2. Copper Tube

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1 1/4"	6 ft. o.c.	3/8"
1 1/2" and 2"	8 ft. o.c.	3/8"
2 1/2" to 3 1/2"	10 ft. o.c.	5/8"

3. Cast Iron Soil Pipe (No-Hub)

Supports for horizontal or vertical no-hub pipe shall be on each side of every stainless steel coupling except for spaces behind toilet rooms or where many fittings are installed at one location. At these points, support every 5'-0" o.c. and on as many fittings as necessary so that no more than one fitting shall be without a hanger in any 5'-0" space. Rod size shall be the same as for steel pipe above for corresponding pipe size.

4. Cast Iron Soil Pipe (Hub and Spigot)

a. Support vertical piping at base and at each story height but in no case at intervals greater than 20 feet.

b. Support horizontal piping at 5-foot intervals and behind every hub except for spaces behind toilet rooms or where many fittings are installed at one location. At these points, support every 5'-0" o.c. and on as many fittings as necessary so that no more than one fitting shall be without a hanger in any 5'-0" space. Rod size shall be the same as for steel pipe above for corresponding pipe size.

5. Base of Cast Iron Stacks

Bases of cast iron stacks shall be supported on concrete, on brick laid in cement mortar, by metal bracket attached to the building construction, or by equivalent methods. All stacks shall be anchored so as to relieve the load from the base of the stack.

U. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.05 SLEEVES, SEALS, AND ESCUTCHEONS

A. Pipe Penetration through Walls, Partitions and Floors

1. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

2. Sleeves through concrete floors for piping shall have the opening 1/2 inch in diameter larger than the diameter of the insulated pipe passing through. Floor sleeves shall project one inch above floor slab.

3. Pipe insulation shall be omitted at penetrations through fire-rated barriers. In all cases pack the annular space between the pipe (whether insulated or uninsulated) and sleeve with mineral wool. Additionally, at penetrations through fire-rated barriers seal the annular space to retain the fire integrity of the fire-rated barrier with nonhardening through-penetration firestops having F-ratings, compatible with the fire ratings of the barriers in which they are installed, per ASTM E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio Fireshield, Inc., General Electric Company, Dow Corning Corporation, or approved equal.

4. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for 12 inches and larger. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

5. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

6. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be sealed watertight.

7. Piping passing through roof construction shall be provided with counterflashing, consisting of steel rainhood secured all around the pipe and overlapping the flashing.

B. Pipe Penetration through Exterior Foundation and Pit Walls

1. General

a. All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with the pipe sleeves and seals as shown on the Contract Drawings.

b. Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

2. Lead-Oakum Seals

Where "Lead-Oakum" seal is shown on the Contract Drawing, the annular space between the pipe and the sleeve shall be made watertight by caulking with oakum and poured lead, edged and trimmed.

3. Interlocking Modular Seals (Link-Seal)

a. Where "Link Seal" is shown on the Contract Drawings, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide a watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

b. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe, seal, and any coating or insulation to ensure a watertight joint.

c. Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

d. Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Contract Drawings. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Contract Drawings.

e. Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping and appurtenances in accordance with manufacturers' installation procedures, applicable codes and standards, and as specified.

2. Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry to avoid necessity of cutting finished structure.

3. All measurements, both horizontal and vertical, shall be based on established benchmarks. All Work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the Work.

4. Perform necessary cutting and patching in accordance with requirements specified in the Section of Division 2 entitled "CUTTING, PATCHING AND REMOVAL". All openings in existing slabs required for pipe penetrations shall be core drilled.

5. Installation requirements for pipe hangers and supports and pipe penetration sleeves, seals, and escutcheons are specified in 2.04 and 2.05, respectively.

B. Piping

1. Install piping as shown on the Contract Drawings and straight and direct as possible, forming right angles or parallel lines with building walls, neatly spaced, with risers plumb and true.

2. Piping shall pitch back toward system drain valve and any installed low points or pockets shall have a hose end drain valve.

3. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing pipe, thoroughly clean the inside, free of cuttings and foreign matter. Cut all piping square and smooth and make up all joints to required limits.

4. Erect all piping to obtain sufficient flexibility to prevent excessive stresses in materials and excessive bending moments at joints or connections.

5. Make changes in pipe size by the use of reducing fittings. Do not use reducing bushings except by approval of the Engineer. Do not use close or shoulder nipples.

6. Arrange water piping so that system can be completely drained. Where lines are purposely pitched for drainage, a uniform grade shall be maintained. Lines shall be so supported as to prevent pocketing of water. No lines shall have pockets due to changes in elevation unless proper provisions for draining are made.

7. Installed piping shall not interfere with the operation or accessibility of doors and windows; shall not encroach on aisles, passageways and equipment; and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.

C. Pipe Joints

1. Threaded Joints

   Make up threaded joints tight using pipe joint Teflon compound or tape, applied on the male thread only.

2. Flanged Joints

   Make up flanged joints square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.

3. Soldered Joints

   a. Cut ends of tubing square and remove all burrs. Clean inside and outside of tubing with steel wool.

   b. Make joints with non-corrosive paste flux and 95 per cent tin and 5 per cent antimony solder. Cored or lead-containing solder is not permitted.

   c. Remove excess solder while still in plastic state.

   d. Leave a fillet at the wall of the fitting.

   e. Prior to silver soldering, remove the internal parts of all valves or other devices to be installed directly in line.

4. Caulked Joints

   For cast iron pipe with hub, pack hub firmly with hemp or picked oakum and fill with molten lead, using a minimum of twelve ounces of lead for each inch of pipe size per joint and to a one-inch minimum depth. After the lead has cooled, the joints shall be thoroughly caulked, using approved caulking irons, faced smooth and made tight without the use of putty, paint or cement.

5. Compression Joints

   Make compression joint with ASTM C564 neoprene rubber gaskets and lubricant. Gaskets shall match class of pipe and fittings. Make joints in accordance with recommendations of CISPI.

6. Cast Iron No-Hub Joints

No-hub cast iron pipe joint shall be of a coupling type. Each joint shall consist of 2 spigot ends of pipe or fitting, and a sealing sleeve assembly, consisting of a stainless steel shield over a neoprene gasket, held together by stainless steel clamps. The gasket shall be slid over the ends of the two pipes to be joined, then the shield and clamps shall be placed over the gasket. The entire coupling shall be held firmly together by the clamps, by alternately turning the screws to 100-115 in.-lb. torque. Couplings shall be "Clamp-All" type manufactured by Clamp-All Corp., or Husky SD Series 4000 type manufactured by Anaheim foundry Company, or approved equal.

3.02 FIELD TESTS

A. General

1. Perform tests as herein specified on the various piping systems or portions thereof prior to backfilling, painting, concealing or insulating.
2. Notify the Engineer and those authorities having jurisdiction, at least 48 hours in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.
3. Provide and install all equipment and devices required in connection with tests. Provide all necessary materials, supplies, labor and power for the tests.
4. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make the necessary repairs immediately, or, if required by the Engineer, replace defective work with new work without additional cost to the Authority. Repeat tests as directed until the entire installation is proven satisfactory. No temporary method of repairing leaks will be permitted.
5. Where piping installed under this Section is connected to any existing system, such installed piping shall be isolated from the existing system during the performance of the required field tests, unless otherwise directed by the Engineer.
6. The Engineer reserves the right to direct the Contractor not to isolate the newly-installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, all as directed by the Engineer and at no additional cost to the Authority.
7. Dispose of water removed from pipelines in a manner that will not cause damage to any property.
8. Provide and install the required air vents in the piping system tested.
9. All equipment, including water coolers, and all controls and instruments shall be isolated from the piping system during test, as well as during cleaning, disinfecting and flushing procedures.

B. Hydrostatic Tests

1. Storm and Sanitary Drainage and Vent

a. Tightly close all openings in the entire system and fill it with water to the point of overflow above the roof. The water level shall be maintained for one hour.

b. When piping is tested in sections, test piping with a pressure equivalent to a 10-foot water head. The water level shall be maintained for one hour.

c. For piping added, relocated or replaced on existing systems, install a test tee at the lowest elevation of each added, relocated or replaced piece of pipe and fill it with water to overflow level of next highest fixture outlet or drain. The water level shall be maintained for one hour.

2. Domestic Water

a. Cap or plug all outlets, apply a hydrostatic pressure of 125 psi and sustain such pressure for one hour.

b. For piping added, relocated or replaced on existing systems, apply a hydrostatic pressure of 50 psi above the existing system pressure for one hour.

C. Cleaning and Disinfecting

The potable water system shall be disinfected prior to use by a method of disinfection in accordance with the applicable code.

3.03 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Contract Drawings. Painting shall be in accordance with the requirements of Division 9, Section entitled "PAINTING".

3.04 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.03 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system. At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained. A set of such bands shall be affixed at each branch and riser takeoff; adjacent to each valve; at each pipe passage through floor and ceiling construction; at each capped line; and at each pipe passage to an underground area.

B. Valve Tags

Securely fasten valve tags specified in 2.03 A.2 with approved brass chain.

END OF SECTION

SECTION 15410

PLUMBING PIPING AND APPURTENANCES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15410A01 Detailed piping layout drawings, including hanger and support locations and details.

15410A02 List of access doors.

Catalog Cuts

15410B01 Catalog cuts, including product data for the following: Fittings and flanges

15410B02 Catalog cuts, including product data for the following: Valves

15410B03 Catalog cuts, including product data for the following: Hangers and supports

15410B04 Catalog cuts, including product data for the following: Sleeves and escutcheons

15410B05 Catalog cuts, including product data for the following: Valve tags and pipe identification bands

Product Data

15410D01 Piping material and schedule for each piping system.

15410D02 Valve charts and schedules

15410D03 Hanger and support schedule showing manufacturer's figure No., size, location and features of each required hanger and support.

Manuals, Warrantees/Guarantees

15410I01 Submit operation and maintenance manuals, including replacement and spare parts lists for each type of valve.

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DIVISION 15

SECTION 15430

PLUMBING SPECIALTIES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for plumbing specialties.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American National Standards Institute (ANSI)
American Society of Mechanical Engineers (ASME)
American Society of Sanitary Engineering (ASSE)
American Society for Testing and Materials (ASTM)
Plumbing and Drainage Institute (PDI)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Plumbing specialties of the types and sizes required shall have performed satisfactorily for purposes similar to those intended herein, for not less than three years.

B. Entities performing the work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All specialties shall be factory-cleaned, wrapped and packaged in boxes prior to shipping to construction site.

B. Store specialties in clean, dry spaces and protect them from weather.

C. Prior to installation, inspect specialties for damage.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 DRAINS

A. General

1. Drains shall be of types and sizes shown on the Contract Drawings.
2. Special type drains other than those specified in 2.01 B and C below shall be provided as shown on the Contract Drawings.
3. Floor drains shall be provided with vandal proof grates in all areas except mechanical equipment rooms.
4. Drains shall be manufactured by Jay R. Smith Manufacturing Co., Josam Manufacturing Co., Zurn Industries Inc., Tyler Pipe Industries Inc./Wade Division, or approved equal.

B. Floor Drains

1. Toilet Rooms and Finished Areas

   Floor drains shall have cast iron body, with flashing collar, round top with nickel bronze adjustable strainer head; Jay R. Smith No. 2005-A or 2010-A or approved equal.

2. Mechanical Equipment Rooms

   Floor drains shall have cast iron body, with flashing collar, round cast iron grate and slotted sediment bucket; Jay R. Smith No. 2230 or approved equal.

3. Drains receiving indirect waste shall be fitted with a cast iron funnel; Jay R. Smith No. 3581 or approved equal.

C. Roof Drains

1. Roof drains shall have cast iron body with adjustable extension sleeve, flashing collar, and cast iron dome. Provide sump receiver and underdeck clamp for all roofs except poured-in place installations. Drain shall be Jay R. Smith No. 1015 or approved equal.
2. Install roof drains with 6-lb. lead flashing extending 12 inches beyond the outside diameter of the roof drain. Coordinate the installation with other affected Work.

2.02 VENT FLASHING COUPLINGS

A. Where shown on the Contract Drawings, provide cast iron, threaded (upper end) counterflashing sleeves; Jay R. Smith No. 1750 or approved equal.

B. Vents extending through roof shall be flashed watertight. Flashing shall be 6-lb. lead extending not less than 12 inches around the perimeter of the pipe, outside the barrel and terminate 12 inches above the roof with the vent flashing couplings specified above.

2.03 CLEANOUTS

A. Use "Y" (and "TY") fittings for cleanouts; full size "Y" for piping up to 4 inches and not less than 4-inch "Y" outlets for piping 5 inches and larger.

B. Provide cleanouts for storm and sanitary piping at bases of stacks, at changes in direction of horizontal piping, and at 50-foot intervals, minimum, on horizontal runs.

C. Floor cleanout deckplates shall be the following or approved equals:

1. Unfinished areas: Jay R. Smith No. 4226
2. Finished areas: Jay R. Smith No. 4026
3. Tiled areas: Jay R. Smith No. 4146
4. Carpeted areas: Jay R. Smith No. 4026-Y (with carpet marker)

D. Toilet room wall cleanouts shall be cast iron caulk ferrule and cast iron head seal plug with stainless steel cover and center screw; Jay R. Smith No. 4402 or approved equal.

E. Cleanouts at changes of direction of above-floor piping shall be cast iron caulk ferrule with straight threaded, tapered bronze plug; Jay R. Smith No. 4420 or approved equal.

F. All cleanout plugs shall be lubricated with graphite before installation.

G. Cleanouts shall be manufactured by Jay R. Smith Manufacturing Co., Josam Manufacturing Co., Zurn Industries Inc., Tyler Pipe Industries Inc./Wade Division, or approved equal.

2.04 FRESH AIR INLETS

A. Where shown on the Contract Drawings, provide fresh air inlets of perforated wall plate with pipe expander type securing device and spanner type tamperproof locking device; Jay R. Smith No. 9005 or approved equal.

B. Finish of plate shall be polished bronze unless otherwise shown on the Contract Drawings.

2.05 DOMESTIC WATER METERS

Provide water meter(s) of the type and size(s) shown on the Contract Drawings. The meter shall be set horizontally, dial facing upward not more than three feet above floor, properly supported, and installed in accordance with the regulations of the local municipal water company.

2.06 STRAINERS

Where shown on the Contract Drawings, provide strainers of "Y" type with tapped blowdown connections, 150 psi w.w.p., bronze body, and bronze screens. Strainers shall be manufactured by Spirax Sarco Inc., Mueller Steam Specialty Co./MUESSCO, or approved equal.

2.07 GAUGES

A. Provide pressure gauges on water main, at pressure reducing valve assemblies and at other locations shown on the Contract Drawings.

B. Gauges shall be of bronze bourdon tube material, with 4 1/2-inch dial face and aluminum case and shall have a range of 160 psi with an accuracy of 0.5 percent of the scale range. Each gauge shall be provided with a snubber and cock. Pressure gauges shall be Weiss Instruments Inc. "Series UG-1" or approved equal.

2.08 THERMOMETERS

A. Provide thermometers on inlets and outlets of water heaters and circulating pumps, and where shown on the Contract Drawings.

B. Thermometers shall be of "red reading" Mercury, industrial glass type with V-shaped cast aluminum case, adjustable angle face, and stainless steel extension necks to suit insulation thickness, having a 9-inch long scale and a temperature range of 20 degrees F to 180 degrees F with an accuracy of one per cent of the scale range. Thermometers shall be provided with immersion bulb and separable socket. Thermometers shall be Weiss "Vari-Angle Industrial Thermometers" or approved equal.

2.09 AIR CHAMBERS

A. Provide full pipe size, 12-inch high air chambers at each plumbing fixture domestic water supply connection.

B. Provide full pipe size, 24-inch high air chambers at the top of each domestic water riser.

2.10 WATER HAMMER ARRESTORS

A. Provide water hammer arrestors adjacent to all equipment where quick-closing valves are provided and at other locations shown on the Contract Drawings.

B. Sizes and installation procedures of water hammer arrestors shall be in accordance with PDI Standards.

C. Water hammer arrestors shall be Jay R. Smith "Series 5000" or approved equal.

2.11 AIR RELIEF VALVES

A. Provide automatic air relief valves at high points in hot water piping and where shown on the Contract Drawings, with 3/4-inch threaded inlet; class 150 cast iron body and cap; valve, float, leverage and valve seat; and compressed non-asbestos gasket. Pipe drain from relief valves shall spill over to adjacent floor drain, mop sink, or as shown on the Contract Drawings.

B. Relief valves shall be Taco air vent, Model 409, or approved equal.

2.12 NON-FREEZE WALL HYDRANTS

Where shown on the Contract Drawings, provide non-freeze wall hydrants, key operated with 3/4-inch, threaded inlets. Hydrant shall be all-bronze nickel-plated with hose connection, integral vacuum breaker, and stainless steel box with full 180° door opening, nickel-bronze face. Hydrants shall be Jay R. Smith No. 5509 QT, or approved equal.

2.13 HOSE BIBBS

Where shown on the Contract Drawings, provide Woodford Manufacturing Co. Model 24 C hose bibbs or approved equal. Finish shall be rough brass in mechanical or non-finished spaces, and polished chrome-plated in all finished areas. Provide matching finish vacuum breakers at each hose bibb.

2.14 VACUUM BREAKERS

Vacuum breakers shall be bronze body, chrome-plated Watts Regulator Co. Model No. 288A-C or approved equal. Check valve shall be provided at the outlet side of vacuum breaker.

2.15 BACKFLOW PREVENTERS

A. Where shown on the Contract Drawings provide backflow preventers to prevent the backflow of contaminated water into the potable water supply. Each backflow preventer shall be a complete assembly, including tight-closing shutoff valves before and after the device, and shall be protected by a strainer. The design shall include test cocks and a pressure-differential relief valve located between two positive seating check valves. The device shall meet the requirements of ASSE Standards.

B. Backflow preventers shall be of a size shown on the Contract Drawings and shall be CMB Industries/FEBCO Division Model No. 825, Watts Regulator Co. Model No. 909, or approved equal.

2.16 DIELECTRIC FITTINGS

Connections between ferrous and non-ferrous pipe or equipment connections shall be made using isolating union or flange joints as manufactured by Watts Regulator Company, Series 3000, or approved equal.

PART 3. EXECUTION

3.01 INSTALLATION

Install plumbing specialties in accordance with the manufacturers' installation instructions.

3.02 PROTECTION

Upon completion of the installation, remove all protective materials and thoroughly clean all specialties to the satisfaction of the Engineer.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

15430B01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS: Catalog cuts

Product Data

15430D01 Product outlines and dimensions, including required clearance.

15430D02 Components , materials, weights and assembly details.

15430D03 Capacity and and performance data, if applicable;

Construction and Installation Procedures

15430G01 Installation procedures.

Manuals, Warrantees/Guarantees

15430I01 Submit operation and maintenance manuals for all specialties including replacement and spare parts lists.

END OF APPENDIX "A"

DIVISION 15

SECTION 15440

PLUMBING FIXTURES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for plumbing fixtures.

B. Types of plumbing fixtures specified in this Section are:

Water Closets (WC)

Water Closets for Disabled (HC WC)

Urinals (UR)

Urinals for Disabled (HC UR)

Lavatories (LAV)

Lavatories for Disabled (HC LAV)

Counter Top Lavatories

Service Sinks (SS)

Mop Receptors (MR)

Sinks (SK)

Electric Water Coolers (EWC)

Electric Water Coolers for Disabled (HC EWC)

Showers (SHR)

Jail Cell Fixtures

Stainless Steel Plumbing Fixtures

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

Federal Specifications

New York City Building Code

New Jersey Uniform Construction code

American National Standards Institute (ANSI)

Air Conditioning and Refrigeration Institute (ARI)

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

American Society of Sanitary Engineers (ASSE)

American Society for Testing and Materials (ASTM)

American Society of Mechanical Engineers (ASME)

Underwriters Laboratories Inc. (UL)

National Electrical Code (NEC)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Plumbing fixtures, of types, styles and configurations required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

B. Handle plumbing fixtures carefully to prevent breakage and chipping and scoring of fixture finish.

C. Store plumbing fixtures in a dry location, and preferably on elevated platforms.

1.05 SUBMITTALS

Refer to Appendix A.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide plumbing fixtures of one of the following manufacturers or an approved equal:

A. Plumbing Fixtures and trim (WC, HC WC, UR, HC UR, LAV, HC LAV, SS, Counter Top Lavatories)

American Standard Inc./US Plumbing Products

Crane Plumbing

Eljer

Kohler Co.

B. Plumbing Trim (Brassware)

American Standard Inc.

Chicago Faucet Co.

Delta Faucet Co., Div. of Masco Corp.

Moen Group; Stanadyne Corp.

C. Flush Valves

Coyne & Delany Co.

Sloan Valve Co.

D. Fixture Seats

Sperzel Industries Inc.

Sanderson Plumbing Product Inc./Beneke Div.

Olsonite Corp.

E. Electric Water Coolers

Elkay Manufacturing Co.

Halsey Taylor

Haws Drinking Faucet Co.

Sunroc Corp.

F. Service Sinks

Kohler Co.

Elkay Manufacturing Co.

American Standard Inc.

Crane Plumbing

Stern-Williams Co., Inc.

G. Sinks

Acorn Engineering Co.

American Standard Inc.

Elkay Manufacturing Co.

Just Manufacturing Co.

H. Mop and Shower Receptors

Stern-Williams Co. Inc.

Crane Plumbing

I. Showers and Trim

American Standard Inc.

Bradley Corp.

Kohler Co.

Leonard Valve Co.

Moen Group; Stanadyne Corp.

Powers Process Controls

J. Fixture Supports

J.R. Smith Manufacturing Co.

Josam Co.

Tyler Pipe/Wade Div.

Zurn Industries Inc./Hydromechanics Div.

K. Jail Cell Fixtures

Acorn Engineering Co.

Bradley Corp.

2.02 MATERIALS

A. Exposed surfaces which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished fixtures shall not be used.

B. Where fitting, trim and accessories are exposed or semi-exposed, provide bright chrome-plated fixtures. Provide copper or brass where not exposed. All exposed piping, fittings, valves, stops, traps, escutcheons, washers, nuts, etc. shall be chromium-plated with polish finish. All exposed aerators, nuts, bolts, trim, handles, etc., installed on any fixture for use by the general public, shall be made vandalproof.

C. Stainless steel sheets shall conform to ASTM A 167, for type specified in 2.03 and shall be of hardest workable temper.

D. Vitreous china shall be high quality, free from fire cracks, spots, blisters, pinholes and specks. Glaze exposed surfaces, and test for crazing resistance in accordance with ASTM C 554.

E. Fiberglass shall conform to ANSI Z 124.2, smooth surfaced, with color selected by the Engineer.

2.03 CONSTRUCTION FEATURES

A. General

1. Provide factory-fabricated fixtures of types and styles shown on the Contract Drawings. For each type fixture, provide fixture manufacturer's trim, carrier, seats, valves, etc., as required for complete unit. All fixtures of the same type shall be furnished by the same manufacturer.

2. Unless otherwise specified herein, comply with applicable Federal Specification WW-P-541 Series sections pertaining to plumbing fixtures, fittings, trim metals and finishes. Comply with requirements of WW-P-541 Series relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this Section are not specified in WW-P-541 Series.

3. Plumbing Fixtures shown on Contract Drawings and specified herein are based on specific descriptions, manufacturers, and model numbers. Other manufacturers of these products will be considered acceptable if approved as equal by the Engineer.

B. Water Closets (WC)

Kohler K-4330 "Kingston Lite" white vitreous china, 1.5 gallon flush, elongated bowl, wall hung, siphon jet flushing, 1 1/2-inch top spud; K-4670, white collar, "LUSTRA" solid plastic seat, with open front with concealed stainless steel check hinge. Connect with exposed Sloan Royal No. 111 low consumption (LC), quiet action, chrome, water conserving flush valve complete with non-hold-open, nickel-silver handle, screw driver angle stop with protecting cap, vacuum breaker, 1 1/2-inch outlet spud coupling with flange and cast brass wall escutcheon with set screw. Adjustable closet fitting and support shall be floor-bolted, block base type.

C. Water Closets for Disabled (HC WC)

Same as specified in 2.03 B above except that the rim height shall be set at 19 inches above finished floor.

D. Urinals (UR)

Kohler K-4960-T "Bardon Lite", white vitreous china washout urinal, less than 1 gpf, with extended shields, integral flush spreader, 3/4-inch top spud, outlet connection threaded 2 inches inside with bolts, washers, hangers and removable beehive strainer. Connect with exposed Sloan Royal No. 186-1, low consumption (LC), quiet action, chrome, water conserving flush valve, complete with screw drive angle stop with protecting cap, vacuum breaker, non-hold-open, nickel-silver handle, 3/4-inch outlet spud coupling with flange and cast brass wall escutcheon with set screw. Supports shall be floor-bolted, block base type.

E. Urinals for Disabled (HC UR) (or Juvenile)

Kohler K-5024-T "Darfield-Lite", white vitreous china washout urinal, less than 1 gpf, elongated lip, 3/4-inch top spud, 1 1/2-inch outlet, wall hanger, removable strainer, tailpiece, K-9200 "P" trap, and fitted with flush valve as specified in 2.03 D above.

F. Lavatories (LAV)

Kohler K-2054 "Jamestown", 20-inch x 18-inch, white vitreous china, front overflow lavatory, drilled for concealed carrier arms; pair K-7622 1/4-inch threaded offset tailpieces; pair K-7601 3/8-inch threaded supplies with loose key angle stops, reducers and cast brass escutcheons with set screws; K-9010,

1 1/4-inch x 1 1/2-inch cast brass "P" trap with cleanout, slip inlet, threaded outlet; K-9015 1 1/2-inch x 6-inch trap nipple, and cast brass escutcheon with set screw; K-7715 drain assembly with perforated strainer. Faucet shall be Delta Model 501 lever handle chrome faucet, less lift rod and waste and fitted with a vandalproof flow regulator spout aerator, limiting the flow to a maximum of 1/2 gpm. Support shall be floor-bolted, block base type.

G. Lavatories for Disabled (HC LAV)

Kohler K-2054 "Jamestown" (20-inch x 18-inch) or Kohler K-12636 "Morningside" (20-inch x 27-inch), white vitreous china, as shown on the Contract Drawings; front overflow lavatory, drilled for concealed carrier arms; K-13885 drain plug assembly with integral perforated grid; pair K-7622 1/4-inch threaded offset tailpieces; pair K-13711 3/8-inch threaded extended supplies with loose key angle stops, reducers and cast brass escutcheons with set screws; K-9010, 1 1/4-inch x 1 1/2-inch cast brass "P" trap with cleanout, slip inlet, threaded outlet; K-9015 1 1/2-inch x 6-inch trap nipple, and cast brass escutcheon with set screw. Faucet shall be gooseneck, chromed, K-13358 with 4-inch handles, 3/4 gpm flow regulated spout aerator and 1/2-inch threaded inlets and coupling nuts on 4-inch centers. Support shall be floor-bolted, block base type.

H. Counter Top Lavatories

Kohler K-2195 "Pennington", 20-inch x 17-inch, white vitreous china, front overflow, self-rimming; pair K-7622 1/4-inch threaded offset tailpieces; pair K-7601 3/8-inch threaded supplies with loose key angle stops, reducers and cast brass escutcheons with set screws; K-9010 1 1/4-inch x 1 1/2-inch cast brass "P" trap with cleanout, slip inlet, threaded outlet; K-9015 1 1/2-inch x 6-inch trap nipple, and cast brass escutcheon with set screw; K-7715 drain assembly with perforated strainer. Faucet shall be Delta Model 501, lever handle chrome faucet, less lift rod and waste and fitted with a vandalproof flow regulator spout aerator, limiting the flow to a maximum of 1/2 gpm.

I. Service Sinks (SS)

Kohler K-6718 "Bannon", 22-inch x 18-inch, enameled cast iron, plain back, wall hanger; K-8936 stainless steel rim guard; K-6673 "P" trap, standard with strainer; K-8904 wall-mounted chrome faucet with loose key stops in shank and vacuum breaker.

J. Mop Receptors (MR)

Precast terrazzo receptor shall be Elfin by Stern-Williams, or approved equal, with 3-inch, integrally cast, chrome-plated brass drain connection, 6-inch high x 36-inch x 24-inch (unless otherwise shown on the Contract Drawings) made of marble chips cast in gray portland cement to produce a minimum compressive strength of 3,000 psi at 28 days. Exposed edges and tops of curbs shall be fitted with 18-gauge, integrally cast, Type 302, stainless steel guard. The supply fitting shall be Kohler K-8904 wall-mounted chrome faucet with loose key stops in shank and vacuum breaker.

K. Sinks (SK)

Elkay "Lustertone", size and model as shown on the Contract Drawings, 18-gauge, Type 302, self-rimming, stainless steel, counter top sink. Sink shall be fitted with Elkay LK-4100 faucet, LK-35 crumb cup strainer, "P" trap and loose key angle stops.

L. Electric Water Coolers (EWC)

Elkay Model EWA-8, surface-mounted, having a cooling capacity of 8.9 gallons per hour from 80 degrees F inlet water to 50 degrees F drinking water at room temperature of 90 degrees F. Water coolers shall comply with requirements of UL 399, ARI Standard 1010, and ASHRAE Standard 18.

M. Electric Water Coolers for Disabled (HC EWC)

Elkay Model EHFSA-8, surface-mounted, wheel chair level model, having a cooling capacity of 8 gallons per hour from 80 degrees F inlet water to 50 degrees F drinking water at room temperature of 90 degrees F.

N. Showers (SHR)

Shower floor receptor shall be precast terrazzo 36-inch x 36- inch with 2-inch brass, integrally cast drain connection and stainless steel strainer plate. Receptor shall be Stern-Williams "Trieste" Model 54. Terrazzo shall be made of black and white marble chips cast in white portland cement to produce a compressive strength of not less than 3000 psi at 28 days. The shower shall be fitted with a Powers P902H-J-1 shower unit, with pressure-balancing mixing valve, integral service stops and 2 gpm flow restrictor in shower head.

O. Jail Cell Fixtures

Acorn Model 1420 Lav/Toilet combination fixture, angled or offset as shown on the Contract Drawings, fabricated from 14 gauge Type 304 stainless steel, integrally reinforced. Construction shall be seamless welded, and exposed surfaces shall have a satin finish. It shall include, but not be limited to a lavatory bowl in a rectangle countertop, cabinet, toilet bowl, integral seat, trap, and trap enclosure. Countertop shall be a minimum 12-inch x 20-inch with integral rectangular lavatory and an air-circulating self-draining dish. Toilet shall be blowout jet type, with an elongated bowl, a self-draining crevice-free flushing rim, and an integral contoured seat with a sanitary high polish finish. Toilet trap shall be capable of passing a 2 5/8-inch diameter ball, and shall be fully enclosed. Cabinet interior shall be sound-deadened with a vermin-proof and fire-resistant material. Fixture shall be capable of withstanding a load of 5,000 pounds without permanent damage. Provide the following with the fixture:

1. Acorn Penal-Trol single temperature lavatory valve (Acorn Option 01);
2. Acorn standard fast lavatory drain, with integral P-trap (Acorn PT) and a thru-wall extension with cleanout (Acorn LW2);
3. Fully-recessed toilet tissue holder (Acorn PH);
4. Acorn flush valve (Acorn FV) with push-button mounted backsplash. Valve shall be complete with vacuum breaker and push button. All exposed parts shall be chrome-plated. Provide a brass thru-wall flushing connection (Acorn FVT);
5. Acorn standard gasketed waste (Acorn GW) plus a yoke assembly to connect to a 3-inch or 4-inch no-hub waste line (Acorn YA3 or YA4, respectively) as indicated on Contract Drawings.

P. Stainless Steel Plumbing Fixtures

1. Water Closets

Acorn Model No. 2105, wall hung, top supply toilet, siphon jet type, made with Type 304 stainless steel, elongated bowl, Acorn HS hinged white plastic seat, Acorn FV flush valve with vacuum breaker. Toilet shall be seamless welded, and exposed surfaces shall have a satin finish. Toilet trap shall pass 2 5/8-inch diameter ball and be fully enclosed. Toilet waste outlet shall be gasketed waste. Adjustable closet fitting and support shall be floor-bolted, block base type.

2. Urinals

Acorn Model No. 2167, wall hung, Type 304 stainless steel urinal. Top supply washout type, Acorn FV flush valve with a vacuum breaker and push button, Acorn FVC stainless steel vandalproof cover and "P" trap. Support shall be floor-bolted, block base type.

3. Lavatories

Acorn Model No. 1951, wall hung, 18-inch x 18-inch rectangular lavatory, with 14-inch x 12-inch x 6-inch deep bowl. Fixture shall be fabricated from type 304 stainless steel. Construction shall be seamless welded, with satin-finish exterior. Lavatory deck shall have an integral air-circulating, self draining soap dish. Provide deck-mounted valve assembly (Acorn CSS), grid strainer (Acorn GT), chrome-plated brass supply with stop, "P" trap (Acorn TT). Manufacturer shall furnish a wall mounting bracket. Support shall be floor-bolted, block base type.

4. Drinking Fountains

Acorn Model No. 1670-1 front access drinking fountain, fabricated from type 304 stainless steel. Construction shall be seamless welded, with satin-finish exterior. Cabinet bottom shall be removable and secured with tamper-resistant screws. Cabinet interior shall be sound-deadened with fire-resistant material. Fixture shall be furnished complete with bubbler, self-closing valve, a removable P-trap, a fast drain, and mounting hardware.

PART 3. EXECUTION

3.01 EXAMINATION

Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures; examine floors and substrates, and conditions under which fixture installation is to be accomplished. For electrical water coolers, coordinate field electrical wiring requirements specified in Division 16 Sections of the Specifications. Do not proceed with installation of fixtures until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. *Install plumbing fixtures in locations shown on the Contract Drawings, in accordance* with manufacturers' installation procedures.

B. Unless otherwise shown on the Contract Drawings, fixtures shall be installed at the following heights:

1. Water Closets (WC) - Rim height shall be 15 inches "above finished floor" (AFF).
2. Water Closet for Disabled (HC WC) - Rim height shall be 19 inches AFF.
3. Lavatories (LAV) - Top of basin shall be 31 inches AFF.
4. Lavatories for Disabled (HC LAV) - Bottom of apron shall be 29 inches AFF with 17 inches clear depth underneath. Install trap parallel with back wall. Insulate water supplies and trap.
5. Urinals (UR) - Rim height shall be 24 inches AFF.
6. Urinals for the Disabled (HC UR) - Rim height shall be 17 inches AFF with supply handle a maximum of 44 inches AFF.
7. Electric Water Coolers
   a. Electric Water Coolers (EWC) - Rim height shall be 40 inches AFF.
   b. Electric Water Coolers for Disabled (HC EWC) - Bottom of apron shall be 27 inches AFF with 17 inches clear depth underneath.
8. Shower - Bottom of shower head to floor shall be:
   a. 65 inches for male shower;
   b. 60 inches for female shower.
9. All other fixtures shall be installed in accordance with manufacturers' recommendations.

C. Grout or caulk area where fixture surfaces rest against wall or floor surfaces with Keene White Plaster or silicone caulking.

D. Fasten plumbing fixtures securely to supports or building structures. Ensure that fixtures are level and plumb. Secure supply lines behind or within wall construction so as to be rigid and not subject to pull or push movements.

E. Clean plumbing fixtures, trim and strainers of dirt and debris upon completion of installation.

F. Protect installed fixtures from damage during remainder of construction period.

3.03 FIELD TESTS

Upon completion of installation of fixtures and after the piping test specified in another Section of these Specifications is completed, operate the fixtures to demonstrate proper performance to the satisfaction of the Engineer.

3.04 ADJUSTMENTS

Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to assure proper performance in accordance with the manufacturers' recommendations and to the satisfaction of the Engineer.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15440A01 Shop drawings indicating dimensions, roughing-in requirements, and method of assembly of components and anchorage.

15440A02 Electrical wiring diagrams.

Catalog Cuts

15440B01 Catalog cuts of plumbing fixtures and associated accessories and appurtenances.

Product Data

15440D01 Product data of each selected model, including rated capacity, fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details and finishes.

Construction and Installation Procedures

15440G01 Installation procedures.

Manuals, Warrantees/Guarantees

15440I01 Maintenance manual for each type of plumbing fixture and accessory, including replacement and spare parts lists.

END OF APPENDIX "A"

THE PORT AUTHORITY OF NY & NJ

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PQL

F.F.
J.S.
HDR/PB, A Joint Venture

BAYONNE BRIDGE

BAYONNE BRIDGE - REPLACEMENT OF MAIN SPAN ROADWAY AND APPROACH STRUCTURES

CONTRACT AKB-264.039

APRIL 2013

Volume 3 of 3

This proposal is not complete unless bidder's Signature appears on page 29

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16859	ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)
16860	ELECTRIC HEATERS
16936	SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

Figure 1 Noise Sensitive Zones

Schedule of Minimum Wage Rates (FED NJ)
Schedule of Minimum Wage Rates (FED NY)
Notification of M/WBE On-line Directory and Forms
Schedule A
Schedule B
Schedule C
Schedule D
Analysis of Bid

DIVISION 15

SECTION 15457

GAS-FIRED WATER HEATERS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for gas-fired water heaters.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American Gas Association (AGA)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
BOCA National Energy Conservation Code
National Fire Protection Association (NFPA)
New Jersey Uniform Construction Code
New York City Building Code
New York State Energy Conservation Construction Code
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of gas-fired water heaters shall be as specified in the Gas-Fired Water Heater Schedules (hereinafter in this Section "Schedules") shown on the Contract Drawings.

C. Water storage tanks shall be designed and constructed in accordance with ASME Code and bear the ASME label.

D. Gas-fired water heater design shall be certified by AGA.

1.03 QUALITY ASSURANCE

Gas-fired water heaters, of types and capacities required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver water heaters and components in factory-fabricated protective packaging.

B. Handle water heaters and components carefully to prevent breaking, denting and scoring.

C. Store water heaters and components in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading water heaters and moving them to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section provide gas-fired water heaters of one of the following manufacturers, or approved equal:

A.O. Smith Water Products Co.
Rheem Manufacturing Co.
State Industries Inc.

2.02 CONSTRUCTION FEATURES

A. Water heaters shall be equipped to burn natural gas and shall be of sizes, arrangements, heat input ratings, recovery rates, and storage tank capacities as specified in the Schedules and as shown on the Contract Drawings.

B. Heaters shall have 150 psi working pressure, extruded high-density magnesium anode rods for cathodic protection, and glass-lining on internal surfaces exposed to water.

C. Controls shall regulate the gas supply to main and pilot burners.

D. Provide each water heater with an automatic gas shut-off device in event of excessive temperature in the tank, a pilot safety shut-off in case of pilot failure, and an AGA approved draft diverter.

E. The heater shall be factory insulated and enclosed with an outer jacket having a baked enamel finish.

F. Provide drain valve in the front of heater for ease of servicing.

G. Provide minimum 3/4-inch AGA approved relief valves.

2.03 SHOP TESTS

Perform manufacturer's standard shop tests and tests required by provisions of AGA and ASME.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install water heaters in accordance with manufacturer's installation procedures. Install heaters plumb and level, firmly anchored in locations shown on the Contract Drawings and maintain manufacturer's recommended clearances for service and maintenance.

B. Connect hot and cold water piping to heaters with shut-off valves and unions.

C. Provide thermometers on inlet and outlet piping of water heaters.

D. Extend relief valve discharge to closest floor drain unless otherwise shown on the Contract Drawings.

E. Connect gas supply line with drip leg, tee, gas cock, and union.

F. Field install all electrical devices furnished under this Section.

G. Verify that electrical wiring installation is in accordance with Engineer-approved manufacturer's submittal and in accordance with installation requirements of Division 16.

3.02 FIELD TESTS

Start up, test, and adjust water heaters in accordance with manufacturer's start-up instructions.

END OF SECTION

SECTION 15457

GAS-FIRED WATER HEATERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15457A01 Shop drawings indicating dimensions, required clearances, and methods of assembly of components.

15457A02 Electrical wiring diagrams for interlock and control. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

Catalog Cuts

15457B01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS: Catalog cuts

Product Data

15457D01 Product data including rated capacities, recovery rates, operating weights, specialties and accessories.

Manufacturer Test Reports

15457F01 Submit certificates of shop inspection and data report required by provisions of AGA and ASME

Construction and Installation Procedures

15457G01 Installation procedures

Manuals, Warrantees/Guarantees

15457I01 Submit operation and maintenance manuals, including replacement and spare parts lists.

END OF APPENDIX "A"

DIVISION 15

SECTION 15459

ELECTRIC WATER HEATERS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for electric water heaters.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State, and Local laws, ordinances, regulations and codes and the latest industry standards including, but not limited to the entities listed below.

New York City Building Code
New Jersey Uniform Construction Code
New York State Energy Conservation Construction Code
The BOCA National Energy Conservation Code
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
Underwriters Laboratories Inc. (UL)
National Electrical Code (NEC)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of electric water heaters shall be as specified in the Electric Water Heater Schedules (hereinafter in this Section "Schedules") shown on the Contract Drawings.

C. Water storage tanks shall be designed and constructed in accordance with ASME Code and bear the ASME label.

D. Electric water heaters shall be UL listed.

1.03 QUALITY ASSURANCE

Electric water heaters, of types and capacities required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver water heaters and components in factory-fabricated protective packaging.

B. Handle water heaters and components carefully to prevent breaking, denting and scoring.

C. Store water heaters and components in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading water heaters and moving them to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section provide electric water heaters of one of the following manufacturers, or approved equal:

A.O. Smith Water Products Co.
Rheem Manufacturing Co
State Industries Inc.

2.02 CONSTRUCTION FEATURES

A. Electric water heaters shall be of sizes, arrangements, capacities, recovery rates, and electrical characteristics as specified in the Schedules and as shown on the Contract Drawings.

B. Heaters shall have 150 psi working pressure, extruded high-density magnesium anode rods for cathodic protection and glass lining on internal surfaces exposed to water.

C. Number and watt density of electric heating elements shall be as specified in the Schedules shown on the Contract Drawings. Provide a thermostat and a high temperature cut-off switch for each heating element.

D. The heater shall be factory-insulated and enclosed with an outer jacket having a baked enamel finish. The heater shall be provided with full-size control compartment for service and maintenance through front panel openings.

E. Provide drain valve in the front of heater for ease of servicing.

F. Provide minimum 3/4-inch NPT relief valves.

G. Provide electrical junction boxes with heavy-duty terminal blocks.

2.03 SHOP TESTS

Perform manufacturer's standard shop tests and tests required by provisions of ASME Boiler and Pressure Vessel Code.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install water heaters in accordance with manufacturer's installation procedures. Install heaters plumb and level, firmly anchored in locations shown on the Contract Drawings and maintain manufacturer's recommended clearances for service and maintenance.

B. Connect hot and cold water piping to heaters with shut-off valves and unions.

C. Provide thermometers on inlet and outlet piping of water heaters.

D. Extend relief valve discharge to closest floor drain unless otherwise shown on the Contract Drawings.

E. Field install all electrical devices furnished under this Section.

F. Verify that electrical wiring installation is in accordance with Engineer-approved manufacturer's submittals and in accordance with installation requirements of Division 16.

3.02 FIELD TESTS

Start up, test, and adjust water heaters in accordance with manufacturer's start-up instructions.

END OF SECTION

SECTION 15459

ELECTRIC WATER HEATERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15459A01 Shop drawings indicating dimensions, required clearances, and methods of assembly of components.

15459A02 Electrical wiring diagrams for electrical power supply, interlock and control. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

Catalog Cuts

15459B01 Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS: Catalog cuts

Product Data

15459D01 Product data including rated capacities, recovery rates, operating weights, specialties and accessories.

Manufacturer Test Reports

15459F01 Submit certificates of shop inspection and data report required by provisions of ASME Boiler and Pressure Vessel Code.

Construction and Installation Procedures

15459G01 Installation procedures.

Manuals, Warrantees/Guarantees

15459I01 Submit operation and maintenance manuals, including replacement and spare parts lists.

END OF APPENDIX "A"

DIVISION 15

SECTION 15488

NATURAL GAS PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for natural gas piping and appurtenances.

B. All gas service main piping up to the gas meter will be installed by the local gas utility company. Coordinate this service main piping and the gas meter assembly installation with the utility company, and provide an entrance sleeve as required by the utility company.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local Laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American Gas Association (AGA)

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

Local gas utility company

National Fire Protection Association (NFPA 54)

New York City Building Code

New Jersey Uniform Construction Code

Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Natural gas piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

Refer to Appendix A.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Provide pipe, fittings, and flanges in accordance with the "Pipe, Fittings, and Flanges Schedule" shown within this Section including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of natural gas piping.

B. All welding elbows shall be long radius pattern unless otherwise shown on the Contract Drawings.

C. Nipples shall be extra-heavy shoulder type. No close nipples shall be used. All nipples shall have designation mark of the manufacturer and shall conform to ASTM pipe specifications for system served.

D. Buttwelding fittings shall be manufactured by Grinnell Corp., or approved equal.

E. Unions shall be malleable iron, threaded, conforming to ANSI B16.39.

F. Welding backing rings for buttwelding joints shall be Robvon Backing Ring Co. "Type CC", or approved equal.

G. Gaskets shall be 1/8-inch thick (after compression) for raised face flanges and 1/16-inch thick (after compression) for flat face flanges and shall be stainless steel, spiral-wound, non-asbestos filler, ring type.

H. Screwed fittings shall not be used in underground gas piping or piping buried in concrete; and the piping shall be coated to prevent corrosion. Coatings and their application shall be as per Utility requirements.

I. Gas piping located within crawl spaces or in areas with excessive moisture shall be wrapped and coated as per Utility requirements.

Pipe, Fittings and Flanges Schedule

Gas Pressure Range	Pipe	Fittings and Flanges
Up to 1/2 psig	Black Steel ASTM A 53, Gr.B or ASTM A 120, Schedule 40	Up to 4 inches - Threaded, Using Malleable, Iron, ANSI B16.3, 150 lb. Class 5 inches and Larger - Welded, Using Carbon Steel Fittings, ANSI B16.9, ASTM A 234 Gr. WPB, Same Rating as Pipe, Buttwelding, Forged Carbon Steel Flanges, ASTM A 105, ANSI B16.5, 150 lb. Class
Above 1/2 psig up to 3 psig	Black Steel, ASTM A 53, Gr.B. or ASTM A 120, Schedule 40	Up to 3 inches – Threaded, Using Malleable Iron, ANSI B16.3, 150 lb. Class 4 inches and Larger - Welded, Using Carbon Steel Fittings, ANSI B16.9, ASTM A 234 Gr. WPB; Same Rating as Pipe, Buttwelding, Forged Carbon Steel Flanges, ASTM A 105, ANSI B16.5, 150 lb. Class
Above 3 psig up to5 psig	Black Steel, ASTM A 53, Gr.B. or ASTM A 120, Schedule 40	All sizes - Welded, Using Carbon Steel Fittings, ANSI B16.9, ASTM A 234 GR. WPB; Same Rating as Pipe, Buttwelding, Forged Carbon Steel Flanges, ASTM A 105, ANSI B16.5, 150 lb. Class

2.02 VALVES

A. General

1. Provide types of valves as and where shown on the Contract Drawings.
2. Unless otherwise shown on the Contract Drawings, provide valves of same size as upstream pipe size.
3. Each type of valve shall be the product of one manufacturer, and shall be AGA certified.
4. Valves shall be of one of the following manufacturers, or approved equal:

   a. Plug Valves

      Walworth Co

      Homestead Valves, Div. Olson Technologies

   b. Gas Cocks

      Conbraco Industries, Inc.

      Matco Products, Inc.

B. Plug Valves

1. Valves, 2 1/2 inches and larger, shall be lubricated, iron body, 125 psi w.o.g., flanged ends, wrench operated type.

2. Valves, 2 inches and 1 1/2 inches, shall be lubricated, iron body, 125 psi w.o.g., threaded ends, wrench operated type.

C. Gas Cocks

Valves, 1 1/4 inches and smaller, shall be lever handle or tee head, bronze, straightway, 150 psi w.o.g., threaded ends type.

2.03 ACCESSORIES

A. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of flow. Sets shall be provided in quantities sufficient to accommodate the installation requirements of 3.04 A of this Section.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2 1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A13.1.

c. Adhesive bands shall be W.H. Brady Co. "Quik-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high and valve number shall be 1/2-inch high, on two lines with service designation on the upper line and valve number on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules.

d. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

e. Valve tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

B. Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors will be furnished and installed under other Sections of the Specifications.

2.04 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Provide hangers and supports, with beam clamps, restraints, supplemental steel, inserts, fish plates, mounting devices, etc., to support piping in alignment without sagging or interference, and to permit free expansion and contraction.

C. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

D. Suspend hangers from beam clamps, brackets, fish plates, inserts or by other approved means. Furnish and install any additional miscellaneous steel supports between building framing members as may be required.

E. Support main vertical piping with steel riser clamps.

F. Trapeze type hangers of steel construction, with hold-down U-bolts, may be used for two or more pipes which have a uniform slope throughout.

G. When loads between supports can be expected to cause a sag in the pipe in excess of 1/4 inch, reduce spacing as necessary to stay within such a limit.

H. Provide and install on all supporting rods, a forged steel turnbuckle with top and bottom lockouts having a vertical adjustment of 6 inches, minimum.

I. All pipe hangers, rods, supports, clamps, etc. shall be furnished with a finish of black protective paint.

J. Do not hang piping from other piping and ductwork.

K. Vertical risers shall be supported on every floor and at intervals between floors so that no more than 10 feet of pipe is unsupported.

L. Tabs in metal deck construction shall not be used to support pipe.

M. Provide pipe anchors where necessary to restrain forces due to thermal expansion and contraction of pipe.

N. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

O. Provide pipe guides where necessary to confine movement along the centerline of the pipe due to thermal expansion and contraction between anchors. Guides shall be adequately designed and placed, generally between 20 to 30 feet on centers and an equal distance from the expansion loop.

P. Unless otherwise specifically approved, hanger rod size and spacing shall be within the following limits:

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	8 ft. o.c.	3/8"
1-1/4" to 2"	10 ft. o.c.	3/8"
2-1/2" to 3-1/2"	12 ft. o.c.	1/2"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8"	12 ft. o.c.	7/8"

Q. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co Inc., or approved equal.

2.05 SLEEVES, SEALS, AND ESCUTCHEONS

A. Pipe Penetration through Walls, Partitions and Floors

1. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the outside diameter of the pipe. Sleeve length shall be flush with the finished wall or partition surface.

2. Sleeves through concrete floors for piping shall have the opening 1/2 inch in diameter larger than the outside diameter of the pipe passing through. Floor sleeves shall project one inch above floor slab.

3. Annular spaces between insulated piping and sleeves shall be packed with mineral-wool and sealed to retain the fire integrity of the walls, partitions, and floors with non-hardening through-penetrating firestops having F-ratings compatible with the fire ratings of the barriers in which they are installed, per ASTM E 814.

   Firestop systems shall be UL-approved, and shall be as manufactured by 3M; Bio fireshield, Inc.; General Electric Company; Dow Corning Corporation; or approved equal.

4. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for 12 inches and larger. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

5. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

6. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be sealed watertight.

7. Piping passing through roof construction shall be provided with counterflashing, consisting of steel rainhood secured all around the pipe and overlapping the flashing.

B. Pipe Penetration through Exterior Foundation and Pit Walls

1. General

a. All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with pipe sleeves and seals as shown on the Contract Drawings.

b. Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

2. Lead-Oakum Seals

Where "Lead-Oakum" seals are shown on the Contract Drawings, the annular space between the pipe and the sleeve shall be made watertight by caulking with oakum and poured lead, edged and trimmed.

3. Interlocking Modular Seals (Link-Seal)

a. Where "Link-Seal" is shown on the Contract Drawings, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide a watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

b. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe and seal to ensure a watertight joint. If pipe outside diameter is nonstandard due to coating or insulation, consult the manufacturer for recommendations before proceeding with wall sleeve sizing.

c. Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

d. Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Contract Drawings. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Contract Drawings.

e. Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

C. Gas service entry sleeve shall be in accordance with the local gas utility company's requirements.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping and appurtenances in accordance with manufacturers' installation procedures, applicable codes and standards, and as specified.

2. Coordinate piping installation with other work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry to avoid necessity of cutting finished structure.

3. All measurements, both horizontal and vertical, shall be based on established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the Work.

4. Perform necessary cutting and patching in accordance with requirements specified in Division 2 Section entitled "CUTTING, PATCHING AND REMOVAL." All openings in existing slabs required for pipe penetrations shall be core drilled.

5. Installation requirements for hangers and supports and for pipe penetration sleeves, seals, and escutcheons are specified in 2.04 and 2.05, respectively.

B. Piping

1. Install piping as shown on the Contract Drawings and straight and direct as possible, forming right angles or parallel lines with building walls, neatly spaced, with risers plumb and true.

2. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Cut all pipe square and smooth; make up all joints to required limits.

3. Make changes in pipe size by the use of reducing fittings. Do not use reducing bushings except by approval of the Engineer.

4. Installed piping shall not interfere with the operation or accessibility of doors or windows; shall not encroach on aisles, passageways and equipment; and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.

5. Make all changes in direction using pipe and fittings, only.

6. Make connections to equipment, using flanges or unions.

7. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

8. Use dielectric fittings where dissimilar metals are joined.

9. Install drip-legs in gas piping where shown on the Contract Drawings and where required by the applicable building code.

10. Install piping with 1/64 inch per foot downward slope in direction of flow.

C. Gas Meter Assembly

The gas meter and pressure regulating valves will be furnished by the local gas utility company but shall be installed under this Section in accordance with the local gas utility company's requirements, unless otherwise shown on the Contract Drawings.

D. Pipe Joints

1. Threaded Joints

   Make up threaded joints using pipe joint Teflon compound or tape, placed on the male thread only.

2. Flanged Joints

   Make up flanged joints square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.

3. Welded Joints

   a. Use shielded metal-arc welding or submerged-arc welding process. Direct current shall be used exclusively.

   b. Each welder shall be certified in accordance with ASME Section IX.

   c. All welded pipe joints shall be radiographed. Documentation thereof shall be submitted to the Engineer for acceptance.

3.02 FIELD TEST

A. General

1. Perform tests on the gas piping system or portions thereof prior to painting or concealing.

2. Notify the Engineer and those authorities having jurisdiction at least 48 hours in advance of making the required tests, so that arrangements can be made for their presence to witness the tests.

3. Provide and install necessary equipment, devices, materials, supplies, labor and power required in connection with tests.

4. Should the tests reveal any leaks or deficiencies, make necessary repairs immediately, or, if required by the Engineer, replace defective work with new work without additional cost to the Authority. Repeat tests as directed until the entire installation is proven satisfactory. No temporary method of repairing leaks will be permitted.

5. All equipment, controls, instruments and valves shall be isolated from the piping system during test.

B. Air Tests

Test piping system with compressed air at a pressure 1-1/2 times the maximum working pressure, but not less than six inches of mercury (3 psig). Use a mercury gauge. Test duration shall be not less than one hour for each 500 cubic feet of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet, the test duration may be reduced to 10 minutes. For piping systems having a volume of more than 24,000 cubic feet, the duration of the test need not exceed 24 hours.

3.03 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Contract Drawings. Painting shall be in accordance with the requirements of Section entitled "PAINTING" of Division 9.

3.04 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.03 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe, and no more than 40 feet apart on a piping system. At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained.

B. Valve Tags

Securely fasten valve tags specified in 2.03 A.2 with approved brass chain.

END OF SECTION

SECTION 15488

NATURAL GAS PIPING AND APPURTENANCES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15488A01 Detailed piping layout drawings, including hanger and support locations and details.

15488A02 List of access doors

Catalog Cuts

15488B01 Catalog cuts, including product data for the following: Fittings and flanges

15488B02 Catalog cuts, including product data for the following: Valves

15488B03 Catalog cuts, including product data for the following: Hangers and supports

15488B04 Catalog cuts, including product data for the following: Sleeves and escutcheons

15488B05 Catalog cuts, including product data for the following: Valve tags and pipe identification bands

Product Data

15488D01 Pipe material and schedule.

15488D02 Valve charts and schedules

15488D03 Hanger and support schedule showing manufacturer's figure No., size, location and features of each required hanger and support.

Manuals, Warrantees/Guarantees

15488I01 Submit operation and maintenance manuals, including replacement and spare parts lists, for each type

Inspection Reports

15488O01 Submit field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15491

PLUMBING INSULATION

PART 1. GENERAL

1.01 SUMMARY

This Section specifies insulation requirements for plumbing piping and equipment.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

New York City Building Code
New York State Energy Conservation Construction Code
New Jersey Uniform Construction Code
American Society for Testing and Materials (ASTM)
National Fire Protection Association (NFPA)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. All insulation, including jackets or facings, adhesives, mastics, cements, tapes and glass cloth for fittings shall have composite fire and smoke hazard ratings as tested by ASTM E 84, NFPA 255, and UL 723 procedures, not exceeding a "Flame Spread" of 25 and "Smoke Developed" of 50.

C. Any treatment of jackets or facings to impart flame and smoke safety shall be permanent. The use of water-soluble treatments is prohibited.

1.03 QUALITY ASSURANCE

A. Insulation materials and accessories, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to the construction site in manufacturer's sealed containers with manufacturer's stamp or label affixed, showing fire hazard indexes of products.

B. All insulation components shall be stored at the construction site on pallets or raised platforms with suitable shed enclosures to protect against foreign matter and rain.

C. Before moving insulation materials from storage platforms to construction site, all insulation sections and component materials shall be inspected for damage. Remove damaged materials from construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide insulation materials of one of the following manufacturers, or approved equal:

Schuller International, Inc.
Certain-Teed Corp./Insulation Group
Owens-Corning Fiberglas Corp.
Knauf Fiber Glass

2.02 MATERIALS

A. Piping Insulation

1. Insulation Thickness

Piping System	Pipe Size	Insulation Minimum Thickness*
Domestic Cold Water	up to 6 in.	0.5
	8 in. & larger	0.5
Chilled Drinking Water	All	1"
Horizontal Storm Water	All	0.5
Domestic Hot Water and Hot Water Circulation	1 1/2 in. & smaller	1"
	2 in. & larger	1.5
Floor Drain receiving condensate/ waste from HVAC cooling equipment, plus 15 feet of associated downstream drain piping.	All	0.5
Lavatory Waste Piping, exposed under fixtures for the disabled	All	0.5

Electric Drinking Water Cooler Waste, up to connection with sanitary system	All	0.5

*Weatherproof or frostproof insulation, where shown on the Contract Drawings, shall have 3-inch thickness.

2. Indoor Piping and Frostproof Insulation

   a. Insulation shall be molded fiberglass with factory-applied, pressure-sensitive, lap-sealing system jacket as a vapor barrier.

   b. Molded fiberglass insulation shall conform with ASTM C 547, Class 1.

   c. The insulation shall be Schuller "MICRO-LOK" with AP-T Plus jacket, having a bare insulation K-factor of 0.25 at 75° mean temperature, or approved equal.

   d. Fitting, valve, and flange insulation requirements are specified in 3.02 B.2.

3. Outdoor Piping (or Weatherproof) Insulation

   a. Insulation shall be molded fiberglass with aluminum jacket (ASTM B209, 3003 Alloy, H-14 temper).

   b. Molded fiberglass insulation shall conform with ASTM C 547, Class 1 and shall be Schuller "MICRO-LOK", having a bare insulation K-factor of 0.25 at 75°F mean temperature, or approved equal.

   c. Insulation jacket shall be 0.06-inch thick aluminum for pipe 2 1/2 inches and larger and 0.010-inch thick aluminum for pipe 2 inches and smaller, with a built-in isolation felt.. All seams and joints shall be weatherproof.

   d. Fitting, valve, and flange insulation requirements are specified in 3.02 C.3.

B. Equipment Insulation

1. Insulation Thickness

Equipment	Insulation Thickness
Meter Assembly	1"
Condensate Coolers/ Preheaters	2"
Hot Water Heaters (Field applied insulation)	2"
Storage Tanks	2"

2. Hot Surfaces

   a. Insulation shall be rigid fiberglass board.

   b. Rigid fiberglass board insulation shall conform with ASTM C 612, Type 1 except that the density shall not be less than 3 lbs. per cubic foot. The insulation shall be Schuller "814 SPIN-GLAS", having a bare insulation K-factor of 0.23 at 75°F mean temperature, or approved equal.

   c. Finishing requirements are specified in 3.02 D. 1.

3. Cold Surfaces

a. Insulation shall be flexible blanket fiberglass.

b. Flexible blanket fiberglass insulation shall conform with ASTM C 553, Type I, and shall be Schuller "MICROLITE", having a compressed thickness K-factor of 0.27 at 75°F mean temperature, or approved equal.

c. Finishing requirements are specified in 3.02 D.2.

PART 3. EXECUTION

3.01 PREPARATION

A. Insulation shall be applied only after the piping systems have been hydrostatically tested and approved by the Engineer.

B. Install insulation subsequent to installation of heat tracing and any coating or painting.

C. Surfaces shall be clean of rust, scale, dirt, dust, grease and other foreign matter, and shall be dry before application of insulation.

3.02 INSTALLATION

A. General

1. Install insulation products in accordance with this Section and manufacturer's installation procedures.

2. Insulation shall be continuous through hangers, slabs, walls, ceiling openings and sleeves. Where pipes pass through non-fire rated walls, floors or partitions, the space around the insulated pipe shall be sealed with mineral wool.

3. Omit insulation through fire rated walls and slabs. Terminate insulation at penetration and seal insulation ends with vapor barrier coating. The annular space between the sleeve and bare pipe shall be filled with approved material and sealed to prevent flame spread.

4. Insulate specialties to match those of the systems to which they are connected.

5. Insulate horizontal leader piping to and including the first fitting of the vertical leader.

6. Fill surface imperfections of insulation such as chipped edges, small joints, cracks, voids or holes, with insulation material and smooth all such areas with a skim coat of insulating cement. Makeshift patching or filling with hose driven or blown insulation, because of lack of space, will not be permitted.

7. Do not insulate equipment nameplates, identification tags, stampings and final connections to plumbing fixtures beyond walls.

8. Omit insulation on hot and cold water toilet room group fixture roughing within concealed pipe chases.

9. Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, strainers, buried piping, and pre-insulated equipment.

10. Insulation on all piping at hangers and supports shall be provided with galvanized protection shields or saddles to prevent crushing of insulation and damage to vapor barrier.

11. Install insulation with smooth and even surfaces. Insulation shall be continuous, and be carefully fitted, with side and end joints butted tightly and staggered. Install each continuous insulation course with full-length units of insulation, with single cut piece to complete run. Do not use multiple cut pieces or scraps abutting each other.

12. For cold surface insulation, all openings, joints, laps, and end strips shall be sealed against moisture penetration with fire-retardant vapor barrier.

13. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage. Staples and similar fastening material are prohibited for securing vapor barrier in insulation.

14. Do not apply seal or cement until all previous application of cement and adhesives have thoroughly dried.

15. Hangers and supports which are directly connected to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.

B. Indoor Piping and Frostproof Insulation

1. Longitudinal lap joints and end butt joints shall be sealed with approved adhesive. Butt joints shall be wrapped with a minimum three-inch wide strip of same material as pipe jacket.

2. Fittings, valves, flanges and accessories shall be insulated with compressed fiberglass of two lbs. per cubic foot density and of the same thickness as pipe insulation, wired in place with 18-gauge galvanized steel wire. Apply a uniform coat of fire retardant vapor barrier coating to the entire surface then cover with a factory-fabricated pre-formed insulated fitting cover, with sealed joints. The fire retardant vapor barrier shall be compatible with said insulation cover material.

C. Outdoor Piping Insulation

1. Longitudinal lap joints and end butt joints shall be sealed with approved adhesive.

2. Apply outer metal jackets over insulation. All seams and joints shall be weatherproof.

3. Fittings, valves and flanges shall be covered with either a fabricated metal jacket or matching aluminum fitted cover with sealed weatherproof joints.

D. Equipment Insulation

1. Hot Surfaces

Cut and miter fiberglass board and secure in place with bands or wire on 12-inch centers. Point up all joints with insulating cement. Cover insulation with one-inch hexagonal wire mesh. Apply two coats of mineral wool cement and trowel to a smooth finish. Finish with two coats of Foster (H.B. Fuller Co./Foster Products Div.) 30-36 adhesive, or approved equal.

2. Cold Surfaces

Fit and contour to shape blanket fiberglass and secure in place with bands or wire. Apply two coats of mineral wool cement and trowel to a smooth finish. Finish with two coats of Foster 30-35 vapor barrier finish, or approved equal.

END OF SECTION

SECTION 15491

PLUMBING INSULATION

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

15491B01 Catalog cuts of insulation.

Samples

15491C01 Submit sample of each insulation type required. Affix label on sample, completely describing product.

Product Data

15491D01 Product data and installation procedures for each type, of insulation

Construction and Installation Procedures

15491G01 Schedule showing product number, k-factor, thickness, and furnished accessories for each plumbing system requiring insulation.

END OF APPENDIX "A"

DIVISION 15

SECTION 15501

HVAC - PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for heating, ventilation and air-conditioning (HVAC) piping and appurtenances.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards; including, but not limited to the entities listed below.

American National Standards Institute (ANSI)
American Society of Mechanical Engineers (ASME)
American Society for Testing and Materials (ASTM)
Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of piping systems are as follows:

1. Steam and Condensate Piping

	System		
	Low Press.	High Press.	Medium Press.
Operating Pressure	58-150 psig	16-57 psig	0-15 psig
Operating Temperature	251-360°F	212-305 °F	250 °F
Hydrostatic Test Pressure	225 psi	125 psi	125 psi
Duration of Hydrostatic Test	2 hours	2 hours	2 hours
Design Code (ANSI)	B31.1	B31.1	B31.9

2. Heating Hot Water Piping

Operating Pressure	125 psig
Operating Temperature	150-250 °F
Hydrostatic Test Pressure	200 psi
Duration of Hydrostatic Test	2 hours
Design Code (ANSI)	B31.9

3. Chilled Water Piping

Operating Pressure	125 psig
Operating Temperature	40-60 °F
Hydrostatic Test Pressure	200 psi
Duration of Hydrostatic Test	2 hours
Design Code (ANSI)	B31.9

4. HighTemperature Hot Water Piping

Operating Pressure	300 psig, maximum
Operating Temperature	360-380 °F
Hydrostatic Test Pressure	450 psi
Duration of Hydrostatic Test	2 hours
Design Code (ANSI)	B31.1

5. Condenser Water Piping

Operating Pressure	125 psig
Operating Temperature	80-110 °F
Hydrostatic Test Pressure	200 psi
Duration of Hydrostatic Test	2 hours
Design Code (ANSI)	B31.9

1.03 QUALITY ASSURANCE

A. HVAC piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing Work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Provide pipe (and tube), fittings, and flanges in accordance with the "Pipe, Fittings, And Flanges Schedule" found at the end of the Section, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of piping systems.

B. All welding elbows shall be long radius pattern unless otherwise shown on the Contract Drawings.

C. Where changes of size occur in horizontal piping, provide eccentric type reducing fittings to attain proper drainage and venting of pipeline.

D. All pipe nipples over six inches in length shall be of corresponding material, quality and thickness as the pipe on which they are used. All nipples up to and including six inches in length shall be extra-heavy shoulder type. No close nipples shall be used. All nipples shall have designation mark of the manufacturer and shall conform to ASTM pipe specifications for system served.

E. Buttwelding fittings shall be manufactured by Ladish Company or approved equal.

F. Socket welding fittings shall be manufactured by Crane, Grinnell, or approved equal.

G. Unions for use with cast iron fitting system shall be 250 lb. Class, malleable iron with bronze seats. The unions shall be Grinnell "Figure 554", or approved equal.

H. Welding backing rings for buttwelding joints shall be Robvon Backing Ring Co. "Type CC", or approved equal.

I. Gaskets shall be of materials, thicknesses and types that are compatible with fluids to be handled; and shall be suitable for the design temperatures and pressures.

J. Connections between pipes or between pipes and equipment of dissimilar metals shall be made with isolating union or flange connections, as made by EPCO Sales Inc., or approved equal.

2.02 GATE, GLOBE, AND CHECK VALVES

A. Provide valves as and where shown on the Contract Drawings, in accordance with the "Gate, Globe, And Check Valves Schedule" found at the end of the Section.

B. Provide drain and vent valves that are not shown on the Contract Drawings but are necessary for the proper operation of piping systems, as follows:

1. Drain valves at all water piping low points, conforming to the gate valve specifications for the particular system

2. Manual vent valves at high points of piping conforming to the globe valve specifications for the particular system

C. All gate and globe valves shall be the products of one manufacturer.

D. Swing check valves shall be suitable for installation in the horizontal position.

E. Provide chain wheel operators on all valves six inches and larger, located more than six feet above the floor in the mechanical equipment rooms, unless otherwise shown on the Contract Drawings.

F. Provide motor operators for valves where shown on the Contract Drawings.

G. Valves shall be capable of being repacked while wide open and operating at their rated pressure.

H. Where angle valves are indicated or required, use equivalent of specified globe type.

I. Valves shall be of one of the following manufacturers, or approved equal:

1. Cast Steel Valves

   Crane Co.
   Walworth Co.
   Powell (William) Co.

2. Forged Steel Valves

   Smith Valve Corp.
   Vogt (Henry) Machine Co. Inc.

3. Bronze Valves

   Crane Co.
   Stockham Valves and Fittings, Inc.

4. Silent Check Valves

   Mueller Steam Specialty Co. (MUESSCO)

2.03 BUTTERFLY VALVES

A. Provide butterfly valves where shown on the Contract Drawings.

B. Butterfly Valves, 2-1/2 through 12 inches, shall be flangeless lug type body, rated at 175 psi for water service temperature up to 250 degrees F. Body shall be cast iron (ASTM A 126, Class B) with bronze (ASTM B 62) disc, and stainless steel (ASTM A 416) shaft with bronze bearings, shaft seal. Resilient seat shall be Ethylene Propylene Terpolymer (EPDM).

C. Provide butterfly valves of up to 6 inches with lever type ten-position handles; provide valves 8 inches and larger with totally enclosed worm and gear operators with handwheels. Where shown on the Contract Drawings, off-the-floor valves shall be equipped with chainwheels and chains.

D. Where required, provide butterfly valves with "memory stops" which permit the valves to be closed to a dead tight position and then reopened to the same balanced position.

E. Butterfly valves shall be DeZurik Fig. 632, or approved equal.

2.04 PLUG VALVES

Plug valves for balancing Heating Hot Water and Chilled Water piping systems shall be of the non-lubricated type for balancing and shutoff with memory stop. Valves shall be suitable to 250 degrees F water temperature and shall be DeZurik Series 400, or approved equal.

2 inches and smaller - Screwed, 175 psi Class
2 1/2 through 12 inches - Flanged, 175 psi Class

Valves 6 inches and larger shall be gear operated.

2.05 SAFETY RELIEF VALVES - STEAM

A. Provide safety relief valves in locations and of sizes shown on the Contract Drawings, or as required, for the proper protection of steam piping and equipment.

B. Safety relief valves shall be sized and set to relieve the system so that the resulting pressure does not exceed the maximum allowable working pressure of the vessel or piping system to which it is connected.

C. All such pressure relieving devices shall be equipped with a manual lifting device so that the disc can be lifted from the seat when the pressure in the pipe or vessel is 75 percent of the pressure at which the valve is set to operate.

D. Where two or more required safety relief valves are placed on one connection, the inlet cross-sectional area of this connection shall not be less than the combined inlet areas of all the safety relief valves connected to it.

E. Discharge lines from the outlets of safety relief valves shall be arranged to ensure drainage and to prevent liquid from lodging in the discharge side of the valve. The size of discharge lines, whether individual or combined, shall be such that any back pressure that may develop during valve operation shall not reduce the relieving capacity of the valves below that required to properly protect the vessel or piping.

F. All safety relief valves shall be rated, tested and approved in accordance with the ASME Boiler and Pressure Vessels Code Section VIII, Unfired Pressure Vessels, and shall be National Board Certified. Valves shall be manufactured by Spirax/Sarco, Inc., Kunkle Valve Div., Crosby Valve & Gage Co., or approved equal.

G. For safety relief valves for hot water and chilled water systems refer to Division 15 Section entitled "HYDRONIC SPECIALTIES".

2.06 STRAINERS

A. Provide strainers where shown on the Contract Drawings, in accordance with the "Strainers Schedule".

B. All strainers shall be "Y" type, and strainer screens shall be stainless steel with perforation sizes as indicated on the Contract Drawings.

C. Provide all strainers with tapped blowdown connections.

Strainers Schedule					
				Rating	
Service Features	Size	Fig. No.	Ends	Class	Construction
H.P. Steam & Cond. H.T. Hot Water	2" and smaller	MUESSCO 862	SW	600 ASTM A	Body – Cast Steel, 216 Gr WCB, Bolted Cover
	2-1/2" and larger	MUESSCO 762	FL	300	
M.P. Steam & Cond.	All sizes	MUESSCO 752	FL	250 ASTM A	Body – Cast Iron, 126 Class B or C
L.P. Steam & Cond.	2" and smaller	MUESSCO 11M	SCR	250 ASTM A	Body – Cast Iron, 126 Class B or C
Htg. Hot Water Chilled Water Condenser Water	2-1/2" and larger	MUESSCO 761	FL	150 ASTM A	Body – Cast Steel, 216 GR WCB

2.07 ACCESSORIES

A. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of flow. Sets shall be provided in quantities sufficient to accommodate the requirements of 3.05 A.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2-1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors as indicated below and shall conform to ANSI A 13.1.

System Identity	Background	Letters & Arrows
High Temp. Water	Yellow	Black
Steam	Yellow	Black
Condensate	Yellow	Black
Hot Water	Yellow	Black
Chilled Water	Green	Black
Condenser Water	Green	Black

c. Adhesive bands shall be manufactured by W.H. Brady Co. "Quick-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 GAUGE brass tag with brass chain. Service designation shall be 1/4-inch high on the upper line, and valve number shall be 1/2-inch high on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system which differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules.

d. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

e. Tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

B. Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors shall be furnished and installed under other Sections.

2.08 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Hangers and supports shall include guides, anchors, stops, restraints, welded attachments, insulation saddles, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hangers and supports.

C. All hangers and supports shall conform to requirements of ANSI B31.1 or B31.9 as applicable, MSS SP-58 and SP-69.

D. Structural members required for suspended loads shall be shop fabricated for bolting to building structural members.

E. Do not hang piping from other piping. In no case shall hangers be supported by means of vertical expansion bolts.

F. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

G. Make accurate weight balance calculations to determine the required supporting force at each hanger or support location and the pipe weight load at each equipment connection.

H. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

I. For critical high temperature piping, at hanger locations where the vertical movement of the piping is 3/4 inch or more, or where it is necessary to avoid the transfer of load to adjacent hangers or connected equipment, provide approved constant support hangers. Hangers shall be Grinnell Fig. 80-V and Fig. 81-H, or approved equal. However, where the piping movement occurs at a hanger supporting a portion of piping riser on which a rigid support is also located, variable spring hangers may be used for any amount of expansion up to the full recommended working range of the spring, provided the change in supporting effect of the variable spring is added to the design load of the rigid support assembly.

J. Where transfer of load to adjacent hangers or equipment is not critical, and where the vertical movement of the piping is less than 3/4 inch, variable spring hangers may be used, provided the variation in supporting effect does not exceed 25 percent of the calculated piping load through its total vertical travel.

K. The total travel for constant support hangers shall be equal to actual travel plus 20 percent. In no case shall the difference between actual and total travel be less than one inch.

L. Furnish constant support hangers with travel stops which shall prevent upward and downward movement of the hanger. The travel stops shall be factory installed so that the hanger level is at the "cold" position. The travel stops shall be of such design as to permit future reengagement, even in the event the lever is at a position other than "cold", without having to make hanger adjustments.

M. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from the vertical is greater than four degrees from the cold to hot position of the pipe, the hanger pipe and structural attachments shall be offset in such manner that the rod is vertical in the hot position.

N. Design hangers such that they cannot become disengaged by movements of the supported pipe.

O. Support riser piping independently from the connected horizontal piping.

P. Pipe support attachments to the riser piping shall be riser clamp lugs at each floor level. Welded attachments shall be of material comparable to that of the pipe.

Q. Design supports, guides, and anchors such that excessive heat will not be transmitted to the building steel. The temperature of supporting parts shall be based on a temperature gradient of 100 degrees F per inch of distance from outside surface of the pipe.

R. If removal of existing fireproofing is required for installation purposes, such removal shall be performed by the Contractor and shall be kept to a minimum. The Contractor shall replace all removed fireproofing with new fireproofing to the satisfaction of the Engineer and at no additional cost to the Authority.

S. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

T. For low temperature systems where vertical movements are anticipated, use approved precompressed variable spring hangers. Hangers shall be Grinnell Fig. B268 Series, or approved equal.

U. Use roller for pipe supports where horizontal movement due to expansion and contraction will occur.

V. Provide all rigid hangers with a means of vertical adjustment after installation.

W. Where the piping system is subject to shock loads, such as thrusts imposed by the actuation of safety valves, design hangers with a provision of approved shock-absorbing devices.

X. All hangers and supports shall be painted black or coated, assembled and tagged to identify them for their specific use and locations as shown on the approved shop drawings prior to delivery to the construction site.

Y. Trapeze type hangers of steel construction may be used for two or more pipes which have a uniform slope throughout.

Z. Provide protection saddles for piping carrying fluids with a temperature above 250 degrees F. Provide protection shields at all points of support for piping carrying fluids with a temperature of 250 degrees F or below. Saddles shall be 12-inch long steel plate with notched edges turned up for welding to the pipe. Shields shall be 12-inch long galvanized steel plate with a radius suitable for the required applications.

AA. Support hangers from building steel framing with approved type beam clamps. Provide any additional miscellaneous steel supports between existing framing members as may be required. No hangers shall be supported from metal deck floor. Welding to building structure members will not be permitted unless approved by the Engineer.

BB. Pipe hangers, rods, inserts and clamps shall be those UL approved for their respective uses. Auxiliary hangers shall be installed on the cross mains to overcome the strain put on this piping by the sloped branch lines.

CC. Use only adjustable ring type, copper-plated, carbon steel hangers for uninsulated copper tubing.

DD. Provide pipe anchors where shown on the Contract Drawings and where necessary to restrain forces due to thermal expansion and contraction of pipe.

EE. Provide pipe guides where shown on the Contract Drawings and where necessary to confine movement along the centerline of the pipe due to thermal expansion and contraction between anchors. Guides shall be adequately designed and placed, generally between 20 to 30 feet on centers and an equal distance from the expansion loop.

FF. Unless indicated otherwise on the Contract Drawings, hanger maximum spacings shall comply with MSS Std. SP-69 "Pipe Hangers and Supports - Selection and Application". Hanger rod sizes shall be compatible with hanger spacings, the loads carried by the hangers and the types of hangers utilized.

GG. All hangers and supports shall comply with the requirements specified under Division 15 Section entitled "VIBRATION ISOLATION AND CONTROL".

HH. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.09 SLEEVES, SEALS, AND ESCUTCHEONS

A. Pipe Penetration through Walls, Partitions and Floors

1. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

2. Sleeves through concrete floors for piping shall have the opening 1/2 inch in diameter larger than the diameter of the insulated pipe passing through. Floor sleeves shall project one inch above floor slab.

3. Pipe insulation shall be omitted at penetrations through fire-rated barriers. In all cases pack the annular space between the pipe (whether insulated or not) and sleeve with mineral wool. Additionally, at penetrations through fire-rated barriers, seal the annular space to retain the fire rating integrity of the barrier with non-hardening through-penetration firestops having F-ratings compatible with the fire ratings of the barriers in which they are installed, as determined by ASTM E 814. Firestop systems shall be UL-approved and shall be as manufactured by 3M, Bio Fireshield, Inc., General Electric Company, Dow Corning Corporation, or approved equal.

4. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for 12 inches and larger. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

5. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

6. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be sealed watertight.

7. Piping passing through roof construction shall be provided with counterflashing, consisting of steel rainhood secured all around the pipe and overlapping the flashing.

B. Pipe Penetration through Exterior Foundation and Pit Walls

1. General

a. All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with the pipe sleeves and seals as shown on the Contract Drawings.

b. Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

2. Interlocking Modular Seals (Link-Seal)

a. Where "Link-Seal" is shown on the Contract Drawings, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

b. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer of the modular seals to fit the pipe, seal, and any coating or insulation to ensure a watertight joint.

c. Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

d. Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Contract Drawings. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Contract Drawings.

e. Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping systems and accessories in accordance with manufacturers' installation procedures/recommendations, and the requirements of ANSI B31.1 or B31.9, as applicable and as specified.

2. Coordinate piping with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry to avoid necessity of cutting finished structure.

3. Pipe sizes shall be as shown on the Contract Drawings. Any pipe sizes not shown shall be in proportion to the load carried at the same frictional resistance as adjacent piping.

4. The piping shown on the Contract Drawings shall be considered as diagrammatic. Install piping in every respect suitable for the purpose intended and clearances required.

5. Run all exposed piping perpendicular and parallel to floors and walls.

6. Install all valves and specialties to permit easy operation and access. Provide access for maintenance of equipment to all valves, controls and accessories installed in concealed areas including, but not limited to, furred spaces, hung ceilings and shafts. Install valves with the stems horizontal or vertically upward, unless specifically shown otherwise on the Contract Drawings.

7. Pitch all piping systems for proper drainage. Steam and condensate piping shall have a minimum pitch of one inch in forty feet.

8. All equipment connections shall be provided with screwed unions or flanges for disconnection of equipment.

9. Bend copper tubing with approved tubing benders to prevent deformation of the tubing in the bends. Use approved sweat-to-pipe threaded adapters for connection with valves and other equipment having threaded connections.

10. Low points in piping systems shall be provided with 6-inch long dirt leg and valved drain connection with hose thread. All vents at high points of piping shall be piped to the nearest floor drain or service sink.

11. All piping shall be concealed above furred ceilings, walls, and partitions, except where otherwise shown on the Contract Drawings.

12. Installation requirements for pipe hangers and supports and pipe penetration sleeves, seals and escutcheons are specified in 2.08 and 2.09, respectively.

B. Pipe Joints

1. Threaded Joints

Make up threaded joints tight using pipe joint Teflon compound or tape, applied on the male thread only.

2. Flanged Joints

Make flanged joints square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.

3. Welded Joints

a. Prior to the start of any welding, remove all corrosive products and other foreign matter from the surface to be welded by either scraping, chipping or wire brushing.

b. Weld pipe joint in accordance with ANSI B31.1 or ANSI B31.9, as applicable.

c. Use shielded metal-arc welding or submerged-arc welding process. Direct current shall be used exclusively. Oxy-acetylene welding may be used for socket welded joints.

d. Each welder shall be certified in accordance with ASME Section IX. Such certification shall have been obtained a maximum of one year prior to the performance of Work under this Contract. Only recognized testing agencies, as approved by the Engineer, will be acceptable for certification. Each welder's certificate shall be on file at the construction site and shall be made available to the Engineer upon his request.

e. Each welder shall be assigned an identification mark that shall be stamped on the pipe surface adjacent to each weld performed by him.

f. In making new connections to existing piping systems, drain the minimum length of existing piping necessary and provide any adjustments, adapters and offsets as may be necessary to make connections.

g. In welding to existing piping, attach the ground connections to the existing pipe section. All welds performed in connecting to existing piping will be radiographically inspected by the Engineer.

h. Tees and reducing tees shall be used for all branch connections with the following two exceptions. Where the branch line is smaller than the main, weldolets or threadolets may be used in lieu of tees and where branch line size is less than or equal to the size of the existing piping, weldolets may be used for connections to existing piping.

4. Soldered Joints

a. Cut ends of tubing square and remove all burrs. Clean inside and outside of tubing with steel wool.

b. Make joints with non-corrosive paste flux and 95 percent tin and 5 percent antimony solder. Cored solder is not permitted.

c. Remove excess solder while still in plastic state.

d. Leave a fillet at the wall of the fitting.

e. Prior to silver soldering, remove the internal parts of all valves or other devices to be installed directly in the line.

3.02 PROTECTION, CLEANING, AND FLUSHING

A. Protection

1. Protect entire piping installation from damage during construction.

2. Cover and protect all openings in floors during construction.

B. Cleaning and Flushing

1. Notify the Engineer 72 hours prior to the scheduled cleaning and flushing of the piping systems. Provide temporary piping and equipment required for the cleaning and flushing. Route the discharge to the nearest storm water system.

2. Circulate a chemical detergent solution mixed with water throughout the system for a minimum of four hours. Retain the services of a recognized water treatment laboratory such as Hammond Montell, Inc., or approved equal, to furnish the required type and quantity of cleaning chemicals, supervise the process and analyze the results.

3. After cleaning, flush the system to the satisfaction of the Engineer, with water a minimum velocity of 7 feet per second. All strainers shall be cleaned after flushing.

4. Upon approved completion of the cleaning and flushing, fill the water piping systems with treated fresh water. Provision shall be made to prevent freeze-up in any piping system exposed to freezing temperature conditions.

3.03 FIELD TESTS

A. General

1. Notify the Engineer a minimum of 48 hours in advance of each time a piping system or portion is ready for inspection and tests.

2. Perform all tests prior to backfilling, installing pipe insulation and painting. In areas where piping will be concealed, tests shall be performed prior to concealment.

3. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make necessary corrections immediately and flush, clean and retest the system for the Engineer's approval at no cost to the Authority.

4. Repair or replace any portion of the system installed under this Section that is damaged as a result of test operations at no cost to the Authority.

5. Where piping installed under this Section is connected to any existing system, such installed piping shall be isolated from the existing system during the performance of the required field tests, unless otherwise directed by the Engineer.

6. The Engineer reserves the right to direct the Contractor not to isolate the newly installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, all as directed by the Engineer and at no additional cost to the Authority.

7. Dispose of water removed from pipelines in a manner that shall not cause damage to any property.

8. Isolate all equipment, controls and instruments from the piping system during the required tests.

9. Provide and install necessary equipment, instruments, hardware, temporary piping, vents, drains, and include the necessary personnel required to perform all tests.

B. Hydrostatic Tests

Perform hydrostatic tests for each piping system in accordance with ANSI B31.1 or B31.9, as applicable. The test pressures and duration of tests shall be as specified in 1.02 B.

C. Radiographic Tests

1. Radiography of all welding will be performed by the Authority at the discretion of the Engineer. Fifteen percent of welds of piping systems specified in 1.02 B will be randomly selected for radiographic tests.

2. Provide access to and clearance of areas to allow Engineer's radiographic inspection during normal working hours.

3. Any weld deemed defective, in the opinion of the Engineer, shall be ground out for the full depth and rewelded to the Engineer's satisfaction and at no cost to the Authority. Removal of defective weld material by burning will not be permitted.

3.04 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Contract Drawings. Painting shall be in accordance with the requirements of Section 09910 - "PAINTING".

3.05 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.07 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system.

At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained. A set of such bands shall be affixed at each branch and riser takeoff; adjacent to each valve; at each pipe passage through floor and ceiling construction; at each capped line; and at each pipe passage to an underground area.

B. Valve Tags

Securely fasten valve tags specified in 2.07 A.2 with approved brass chain.

PIPE, FITTINGS, AND FLANGES SCHEDULE

Service (see 1.03 Design Req.)	Pipe			Joints	Fittings		Flanges
	Material	Wall Thickness	Size		Dimension & Material	Rating	Dimension & Material
High Press. Steam and Condensate	ASTM A 106, Gr. B Seamless	Sch. 80	Up to 2"	Socket weld	ANSI B16.11, ASTM A 105	3,000 lb.	ANSI B16.5, 300 lb. Class, ASTM A 105
High Temp. Hot Water		Sch. 40 0.375" Sch. 30	2-1/2" to 10" 12" to 16" 18" to 24"	Butt weld	ANSI B16.9, ASTM A 234 Gr. WPB	Same as pipe	ANSI B16.5, 300 lb. Class, ASTM A 105
Medium Press. Steam and Condensate	ASTM A 53, Gr. B Seamless	Sch. 80	Up to 2"	Socket weld	ANSI B16.11, ASTM A 105	3,000 lb.	ANSI B16.5, 150 lb. Class, ASTM A 105
		Sch. 40 0.375"	2-1/2" to 10" 12" to 24"	Butt weld	ANSI B16.9, ASTM A 234 Gr. WPB	Same as pipe	ANSI B16.5, 150 lb. Class, ASTM A 105
Low Press. Steam and Condensate Pumped Condensate Heating Hot Water, Chilled Water, Condenser Water	ASTM A 53, Gr. B Cont. Weld or ASTM 53, Gr. B Seamless	Sch. 80	Up to 2"	Screwed	Malleable Iron, ASTM A 197	150 lb.	Malleable Iron, 150 lb. Class, ANSI B16.3
					Cast Iron, ANSI B16.4, ASTM A 126, Class B or C	250 lb.	Cast Iron, 250 lb. Class, ANSI B16.4
		Sch. 40 0.375"	2-1/2" to 10" 12" to 20"	Butt weld	ANSI B16.9, ASTM A 234 Gr. WPB	Same as pipe	ANSI B16.5, 150 lb. Class, ASTM A 105
Domestic Cold Water Makeup	ASTM B 88, Type "L" Annealed	Nominal Wall	Up to 2"	Solder 95-5	Wrought Copper, ANSI B16.22	Same as pipe or better	

GATE, GLOBE AND CHECK VALVES SCHEDULE (2 INCHES AND SMALLER)

SERVICE	TYPE	FIG. #	ENDS	RATING CLASS	CONSTRUCTION FEATURES
H.P. Steam & Cond. H.T. Hot Water	Gate	SMITH 830	FL	300	Compliance with MSS SP-84 for socket weld end valves and ANSI B16.34 for flanged end valves. GATES & GLOBES: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and wedges CHECKS: Renewable seats and discs, bolted bonnet MATERIALS: Body & Bonnet – Forged Steel, ASTM A 105 Stem & Disc – 11-14 Chrome, ASTM A 182 F6 heat treated Seat – Base metal stellite
		888W	SW 600 or 800		
	Globe	G83	FL	300	
		G80W	SW 600 or 800		
	Lift Check		FL	300	
		C80W	SW 600 or 800		
M.P. Steam & Cond.	Gate	SMITH 815	FL	150	
	Globe		FL	150	
	Lift Check		FL	150	
L.P. Steam & Cond.	Gate	CRANE 634E	SCR	300	Compliance with MSS SP-80 GATES & GLOBES: Rising stem, back seated, union bonnet, inside screw, solid wedge or plug type disc, integral seat CHECKS: Renewable disc, union bonnet MATERIALS: Body & Bonnet – Bronze, ASTM B 62 for Class 150, B 61 for Class 300 Stem – Bronze, ASTM B 584, Alloy C87600 Seat Ring & Seat – Bronze, ASTM B 62 for Class 150, B 61 for Class 300 Wedge or Disc – Bronze (Gates), ASTM B 62 for Class 150, B61 for Class 300; hardened SS (Globes), AISI 420
	Globe	382P	SCR	300	
	Swing Check	76E	SCR	300	
	Lift Check	366E	SCR	300	
Htg. Hot Water Chilled Water Condenser Water	Gate	CRANE 431UB	SCR	150	
	Globe	14 1/2P	SCR	150	
	Swing Check	137	SCR	150	
	Lift Check	27TF	SCR	150	
Other than H.T. Hot Water (Pump Discharge)	Silent Check	MUESSCO 101M-BP	FL (wafer)	150	Compliance with ANSI B16.34 CHECKS: Guided disc (both top and bottom), spring-loaded, wafer type MATERIAL: Body, Disc & Seat – Bronze, ASTM B 62 Guide Pin & Bushing – ASTM B 584, Alloy C87600

GATE, GLOBE AND CHECK VALVES SCHEDULE (2-1/2 INCHES AND LARGER)

SERVICE	TYPE	FIG. #	ENDS	RATING CLASS	CONSTRUCTION FEATURES
H.P. Steam & Cond. H.T. Hot Water		CRANE			Compliance with ANSI B16.34 for flanged end valves. GATES & GLOBES: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and discs (flexible wedge up to 12", solid wedge for 14" and up), ball bearing yoke (8" and up) CHECKS: Renewable seats and discs, bolted bonnet MATERIALS: Body & Bonnet – Cast Steel, ASTM A 216 Gr. WCB Stem – 11-14 Chrome, ASTM A 182 F6 heat treated Seat & Backseat Facing – Ferritic or austenitic base metal stellite face Disc Facing – 11-14 Chrome, ASTM A 182 F6 heat treated
	Gate	33	FL	300	
		33-1/2	BW	300	
	Globe	151	FL	300	
		151-1/2	BW	300	
	Swing Check	159	FL	300	
		159-1/2	BW	300	
M.P. Steam & Cond. L.P. Steam & Cond. Pumped Cond. Htg. Hot Water Chilled Water Condenser Water		CRANE			
	Gate	47	FL	150	
		47-1/2	BW	150	
	Globe	143	FL	150	
		143-1/2	BW	150	
	Swing Check	147	FL	150	
		147-1/2	BW	150	
H.T. Hot Water (Pump Discharge)	Silent Check	MUESSCO 109M-DT	FL	300	Compliance with ANSI B16.34 CHECKS: Guided disc (both top and bottom), spring-loaded, globe type MATERIAL: Body – Cast Steel, ASTM A 216 Gr. WCB Seat & Disc – ASTM A 351 Gr. CF8M Spring & Guide Bushing – ASTM A 276
Other than H.T. Hot Water (Pump Discharge)	Silent Check	MUESSCO 105M-BP	FL	150	Compliance with ANSI B16.34 CHECKS: Guided disc (both top and bottom), spring-loaded, globe type MATERIALS: Body, Disc & Seat – Bronze, ASTM B 62 Guide Pin & Bushing – ASTM B 584, Alloy C87600
M.P. Steam & Cond.		CRANE			Compliance with MSS SP-70, 72 & 85 Flanged ends per ANSI B16.1 GATES & GLOBES: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), screwed-in seat ring CHECKS: Bolted bonnet, screwed in seat ring MATERIALS: Body & Bonnet – Cast Iron, ASTM A 126 Class B or C Stem – Bronze, brass or nickel plated steel Seat Ring & Seat – Bronze or bronze faced Wedge or Disc – Bronze or bronze faced
	Gate	7 1/2E	FL	250	
	Globe	21E	FL	250	
	Swing Check	39E	FL	150	
L.P. Steam & Cond. Pumped Cond. Htg. Hot Water Chilled Water Condenser Water		CRANE			
	Gate	465 1/2	FL	125	
	Globe	351	FL	125	
	Swing Check	373	FL	125	

END OF SECTION

SECTION 15501

HVAC - PIPING AND APPURTENANCES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15501A01 Shop and coordination drawings shall be double-line and shall be at a minimum of 3/8"=1'-0" scale.

a. Piping layout and installation drawings including, at a minimum, the following:

1. Plans, elevations and sections.
2. Hangers, support locations and details. Indicate methods of attachment to building structure.
3. Pipe elevations and dimensions from main piping runs to a reference point.
4. Penetrations through fire-rated and other partitions
5. Locations for piping accessories, including valves, strainers and access doors.

b. Piping coordination drawings showing plan views, sections, and piping elevations, drawn to scale, on which all items are shown and coordinated with all Work of other Sections.

Product Data

15501D01 a. Pipe material and schedule for each piping system..

b. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at a minimum:

1. Fittings and flanges.
2. Hangers and supports.
3. Sleeves, seals and escutcheons.
4. Pipe identification bands.

c. List of access doors, including sizes and locations.

d. Hangers and support schedule showing manufacturer's figure number, size, location and features of each required hanger and support.

15501D02 a. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at a minimum:

1. Valves, valve operators and strainers.
2. Valve tags.
3. Other items specified in this Section

b. Valve charts and schedules.

Construction and Installation Procedures

15501G01 Field test procedures.

Calculations

15501H01 Piping stress analysis.

Manuals, Warrantees/Guarantees

15501I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, test results, electrical/control devices and electrical/control wiring diagram(s).

Inspection Reports

15501O01 Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15502

REFRIGERANT PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for refrigerant piping and appurtenances.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American National Standards Institute (ANSI)
Air-Conditioning and Refrigeration Institute (ARI)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
American Society for Testing and Materials (ASTM)
Environmental Protection Agency (EPA)
National Electrical Manufacturers Association (NEMA)
American Welding Society (AWS)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Refrigerant piping systems shall be designed in accordance with ANSI B 31.5.

1.03 QUALITY ASSURANCE

A. Refrigerant piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than 3 years.

B. Entities performing work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean and dehydrate copper tube, and seal tube ends with temporary plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store tube, fittings, valves, specialties and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all tube, fittings, valves, specialties and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper tube shall be ASTM B 88, Type K, hard drawn temper, nominal (standard) sizes.

B. Fittings shall be wrought copper, solder-joint, pressure fittings in accordance with ANSI B 16.22 and shall be same rating as pipe.

C. Tubing joints shall be solder joints, using appropriate ASTM B 32 solder metal.

2.02 REFRIGERANT VALVES AND SPECIALTIES

A. General

1. Provide required types, sizes and capacities of refrigerant valves and specialties where shown on the Contract Drawings.

2. Unless otherwise shown on the Contract Drawings, all valves and specialties shall be UL listed and have a rating of 240 degrees F, minimum, and 350 psi working pressure and shall have solder ends.

B. Refrigerant Valves

1. Globe Valves

a. Forged brass body, packed type with back seating and cap seals

b. Forged brass body, packless, diaphragm type with back seating and hermetic seals

2. Check Valves

Forged brass body, accessible internal parts, Teflon synthetic seat, with fully guided piston and stainless steel spring.

Valves shall be operable whether installed horizontally or vertically.

3. Solenoid Valves

Two-way, forged brass or corrosion-resistant steel body, conforming to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 24-volt/60 Hz (unless otherwise shown on the Contract Drawings), with 1/2-inch conduit adapter. Valve with 1/4-inch and smaller ports shall be direct-operated, without manual stem. Valves having a port greater than 1/4-inch shall be pilot-operated and provided with a manual stem. Solenoid valves shall be Parker-Hannifin RB Series, or approved equal.

C. Refrigerant Specialties

1. Strainers

a. Strainers for systems with a capacity of 4 tons or less shall be of the sealed type, having brass or corrosion-resistant steel shall, and stainless steel or monel element capabile of removing particles 15 microns and larger. Strainer shall be Henry Valve Company 891S Series, or approved equal.

b. Strainers for systems with a capacity greater than 4 tons shall be of the replaceable - core type, having a brass or corrosion-resistant steel shell, a steel flange ring and spring, cover plate with cap screws, and corrosion-resistant element, capable of removing particles 15 microns and larger. Strainers shall be Henry Valve Company 866 Series, or approved equal.

2. Moisture-liquid indicators shall have forged brass body, single port, removable cap, polished optical glass. Moisture-liquid indicators shall be Henry Valve Company MI-30 Series, or approved equal.

3. Filter-dryers shall be sealed or replaceable core type as indicated on the Contract Drawings.

a. Sealed filter-dryers shall have corrosion-resistant steel shell, with wrought copper fittings and ceramic-fired, desiccant core. Sealed Filter-dryers shall be Henry Valve Company H Series, or approved equal.

b. Replaceable core filter-dryers shall have corrosion-resistant steel shell with wrought copper fittings, steel flange ring and spring, cover plate with cap screws, replaceable filter-dryer core. Replaceable core filter-dryers shall be Henry Valve Company V8 Series, or approved equal.

4. Thermal expansion valve shall be thermostatic adjustable, modulating type; size as required for specific evaporator requirements and factory set for proper evaporator superheat requirements. Valve shall be complete with sensing bulb, a distributor having a side connection for hot gas bypass line if required, and an external equalizer line.

5. Hot gas bypass valve shall be adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading.

D. Refrigerant valves and specialties shall be manufactured by Sporlan Valve Co., Parker-Hannifin Corp., Henry Valve Co. Inc., or approved equal.

2.03 PIPE AND VALVE IDENTIFICATION

A. Adhesive Bands

1. Provide approved adhesive bands in sets of two, one identifying the system and the second, the direction of flow.

2. For pipe 3 inches and larger, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For pipe 2 1/2 inches and smaller, the letters and the arrow shall be not less than one inch high.

3. Adhesive bands shall be W.H. Brady Co. "Quik-Label", or approved equal.

B. Valve Tags, Charts and Schedules

1. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high and on the upper line. The valve number shall be 1/2-inch high and on the lower line. The characters shall be indented and filled with durable black compound.

2. Provide diagrammatic valve charts and schedules, using a valve numbering system which differentiates between classes of service and indicates floor level of valve location.

3. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules.

4. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

5. Valve tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

2.04 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural and seismic requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Hangers and supports shall include, but not limited to guides, anchors, stops, restraints, welded attachments, insulation saddles, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hanger and supports.

C. All hangers and supports shall conform to requirements of ANSI B 31.5.

D. Do not hang piping from other piping. In no case shall hangers be supported by means of vertical expansion bolts.

E. Keep the types of hangers used to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

F. Support riser piping independently from the connected horizontal piping.

G. Pipe support attachments to the riser piping shall be riser clamp lugs at each floor level.

H. Use only adjustable ring type, copper-plated, carbon steel hangers for uninsulated copper tubing.

I. Provide pipe anchors where shown on the Contract Drawings and where necessary to restrain forces due to thermal expansion and contraction of pipe.

J. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

K. Unless otherwise specifically approved, hanger size and spacing for copper tubing shall be as follows:

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/4" to 2"	7 ft. o.c.	3/8"
2-1/2" to 3"	9 ft. o.c.	1/2"
3-1/2" to 4"	11 ft. o.c.	5/8"

L. All hangers and supports shall comply with the requirements specified under the Section entitled "VIBRATION ISOLATION AND CONTROL."

M. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.05 SLEEVES, SEALS, AND ESCUTCHEONS

A. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

B. Sleeves through concrete floors for piping shall have the opening 1/2-inch in diameter larger than the diameter of the insulated pipe passing through. Floor sleeves shall project one inch above floor slab.

C. Annular spaces between insulated piping and sleeves shall be packed with mineral wool and sealed to retain the fire integrity of the walls, partitions and floors with non-hardening through-penetration firestops having F-ratings compatible with the fire ratings of the barriers in which they are installed, as determined by ASTM E 814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio fireshied, Inc., General Electric Company, Dow Corning Corporation, or approved equal.

D. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

E. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated, cast brass escutcheons with fastening set screws.

F. Piping passing through roof construction shall be provided with counterflashing, consisting of copper rainhood secured all around the pipe and overlapping the flashing, unless otherwise shown on the Contract Drawings.

G. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of waterproof cement compatible with the water proofing membrane. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be packed to ensure a watertight seal.

PART 3. EXECUTION

3.01 PREPARATION

A. Verify cleanliness of all tube, fittings, valves and specialties immediately prior to installation in the refrigeration system.

B. Verify status of all precharged gas-or refrigerant-containing equipment for pressure retention and dehydration status. Replenish gas or refrigerant charges only after verification of internal conditions under the direction of the equipment manufacturer's representative at the construction site.

C. Where necessary, clean refrigerant piping by swabbing with dry, lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

3.02 INSTALLATION

A. Install piping system in accordance with manufacturer's installation procedures, requirements of ANSI B 31.5 and as specified:

B. Coordinate piping installation with other work to avoid interference.

C. The piping layout shown on the Contract Drawings shall be considered as diagrammatic. Install piping suitable in every respect for the work-intended clearances required.

D. Run all piping perpendicular and parallel to walls and floors.

E. Bend copper tubing with approved tubing benders to prevent deformation of the tubing in the bends. Use approved sweat-to-pipe threaded adapters for connection with valves and other equipment having threaded connections.

F. All piping shall be concealed above furred ceilings, in furred walls and partitions, unless otherwise shown on the Contract Drawings.

G. Bleed nitrogen through refrigerant piping during soldering operations and during idle periods of construction work to ensure maintenance of dehydrated status. Maintain 10 psi nitrogen charge with pipe end closures.

H. Install solenoid valves with stem pointing upwards. Wiring of solenoid valves is specified in applicable Sections of Division 16.

I. All equipment connections shall be provided with isolation valved disconnections and pump-down recharge connections.

J. Installation requirements for hangers and supports and for pipe penetration sleeves, seals and escutcheons are specified in 2.04 and 2.05, respectively.

K. Soldered Joints

1. Cut ends of tubing square and remove all burrs. Clean inside and outside of tubing with steel wool.

2. Remove excess solder while still in plastic state.

3. Leave a fillet at the wall of the fitting.

4. Prior to soldering, remove the internal parts of all valves or other devices to be installed directly in the line.

L. Piping shall be so arranged and valved that any part or portion of the system may be cut out of service without pumping down the system, or otherwise interfering with the operation of other portions or equipment in the system.

M. Provision shall be made for attaching pressure gauges, or for the installation of test thermometers. Suitable fittings with wells shall be installed where required for the insertion of temperature control sensing bulbs.

N. In multi-circuit evaporators (split direct-expansion cooling coils), each circuit shall be provided with its individual thermostatic expansion valve, and its own refrigerant solenoid valve. Each solenoid valve shall be provided with a valved bypass and inlet and outlet isolation valves.

3.03 FIELD TESTS

A. Refrigerant Piping Leak Tests

1. Test refrigerant piping in accordance with ANSI B 31.5 and refrigeration equipment manufacturer's recommendations, using inert gas such as nitrogen or carbon dioxide, with leak tracer introduced to the piping system through a pressure regulator and gauge manifold.

2. Maintain 150 psi inert gas test pressure in the piping system. Perform bubble test on all joints and then check complete system with halide torch or electronic leak detector.

3. Maintain 150 psi pressure for 24 hours after tests.

B. Dehydration and Charging System

1. Procedure for dehydration and charging shall meet all requirements of EPA Section 608 of the Clean Air Act of 1990.

2. Install core in the filter-dryer after leak test but before evacuation.

3. Evacuate refrigerant system with vacuum pump until refrigerant pressure reaches the level established by EPA for the type of refrigerant and its ultimate recovery. During evacuation, apply heat to pockets, elbows, and low spots in piping.

4. Maintain vacuum on system for a minimum of 5 hours after closing valve between vacuum pump and system.

5. Break vacuum with refrigerant gas, allow pressure to build up to EPA acceptable level.

6. Complete charging of system, using new filter-dryer core in charging line. Provide full operating charge of refrigerant.

7. Maintain the charged system until startup.

3.04 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Contract Drawings. Painting shall be in accordance with the requirements of Section 09910 "PAINTING".

3.05 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix pipe adhesive bands specified in 2.03 A where they can be easily read and with their long dimension parallel to the axis of the pipe.

At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed, and the identity of the piping system cannot be readily ascertained. As a minimum, a set of such bands shall be affixed at each branch and riser takeoff; adjacent to each valve; at each pipe passage through floor and ceiling construction; at each capped line; and at each pipe passage to an underground area.

B. Valve Tags

Securely fasten valve tags specified 2.03 B with approved brass chain.

END OF SECTION

SECTION 15502

REFRIGERANT PIPING AND APPURTENANCES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15502A01 a. Piping layout drawings (minimum 1/4"=1'-0" scale) including, but not limited to, hangers, support locations, and details
b. Piping coordination drawings (minimum 1/4"=1'-0" scale), showing plan views, sections, and piping elevations, on which all items are shown and coordinated with all Work of other Sections.

Product Data

15502D01 a. Pipe material and schedule for each piping system
b. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at a minimum:
1. Fittings.
2. Hangers and supports.
3. Sleeves, seals and escutcheons.
4. Pipe identification bands.

15502D02 a. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at a minimum:
1. Valves, valve operators and strainers.
2. Valve tags.
b. Valve charts and schedules.

Construction and Installation Procedures

15502G01 Field test procedures.

Manuals, Warrantees/Guarantees

15502I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, test results, electrical/control devices and electrical/control wiring diagram(s).

END OF APPENDIX "A"

15502

DIVISION 15

SECTION 15503

FUEL OIL PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for fuel oil piping and appurtenances.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

National Electrical Code (NEC)

National Fire Protection Association (NFPA)

Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

A. Fuel oil piping systems shall be designed in accordance with NFPA 31, and leak detection system shall comply with National Electrical Code.

1.03 QUALITY ASSURANCE

A. Fuel oil piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Provide pipe (and tube), fittings, and flanges in accordance with the "PIPE, FITTINGS, AND FLANGES SCHEDULE" shown within this Section, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of fuel oil piping.

B. All welding elbows shall be long radius pattern unless otherwise shown on the Contract Drawings.

C. Buttwelding fittings shall be manufactured by Ladish Company, Crane Co., Grinnell Corp., or approved equal.

D. Socket welding fittings shall be manufactured by Crane, Grinnell, or approved equal.

E. Underground fuel oil piping shall consist of a primary (carrier) pipe, completely enclosed within a secondary (containment) pipe. The primary and secondary pipes and fittings shall be manufactured of glass fiber reinforced epoxy resins. Both pipes shall incorporate integral corrosion-resistant resin-rich reinforced liners. The primary pipe shall be centered within the secondary pipe by use of centering spacers furnished by the pipe manufacturer. Adhesive for joining the piping shall be UL listed epoxy, manufactured by pipe manufacturer. Pipe shall be Ameron Co. "Dualoy 3000/L"; Smith Fiberglass Products, Inc. "Red Thread IIa"; or approved equal. The secondary containment pipe shall be sized and configured so that the interstitial space between the primary and secondary pipes will accommodate adequately a leak detection system cable running throughout the length of the pipe. It shall be Contractor's responsibility to coordinate the piping (size and configuration) with the leak detection system specified herinafter in this Section. Means for installing the leak detection cable, and for venting and draining the piping, and for inspecting the leak detection system shall be provided adequately along the length of piping and where required.

F. Required disconnects for above ground piping shall be made up using welding neck flanges.

G. Welding backing rings for buttwelding joints shall be Robvon Backing Ring Co. "Type CC", or approved equal.

H. Gaskets for steel pipe shall be 1/8-inch thick (after compression) for raised face flanges and 1/16-inch thick (after compression) for flat face flanges, and shall be stainless steel, spiral-wound, non-asbestos filler, ring type.

I. Gaskets for glass fiber pipe shall be Class 150 full-face, 1/8-inch thick (after compression) sheet rubber, ANSI B16.21, with a Shore durometer hardness between 55 and 65, ASTM D1330.

J. Gaskets for glass fiber pipe-to-steel pipe flanged joints shall be as described hereinbefore 2.01 I for glass fiber pipe.

K. Piping shall be designed to contain and remain inert to diesel fuel and heating fuel oil.

Pipe, Fittings and Flanges Schedule				
Fuel Oil Above Ground				
Size	Pipe	Joints	Fittings	Flanges
Up to 2"	ASTM A 53, Gr.B, Seamless, Sch. 80	Socket Weld	ASTM A 105, ANSI B16.11, 3000 lb. Rating, Gr. WPB	ASTM A 105, ANSI B16.5, 150 lb. Class
2-1/2" to 10"	ASTM A 53, Gr.B, Seamless, Sch. 40	Butt Weld	ASTM A 234, Gr. WPB, ANSI B 16.9, Same as Pipe Rating	ASTM A 105, ANSI B 16.5, 150 lb. Class
Up to 2"	ASTM B 88 Type K, Drawn, Nominal Wall (where shown on the Contract Drawings)	Solder 95-5	Wrought Copper ANSI B16.22, Same as Pipe Rating	

Fuel Oil Underground		
Pipe	Joints	Fittings
Primary carrier pipe, centered within a secondary containment pipe Both pipes shall be Glass Fiber Reinforced Epoxy Resin Pipe, UL-Listed, ASTM D2310, ASTM D 2996; Grade 1, Type 1, Class C	Bell and Spigot	Same as pipe; flat face only

2.02 GATE, GLOBE, AND CHECK VALVES

A. Provide valves where shown on the Contract Drawings, in accordance with the "Gate, Globe and Check Valves Schedule" shown in this Section.

B. All gate and globe valves shall be the products of one manufacturer.

C. Swing check valves shall be suitable for installation in the horizontal position.

D. All valve Figure Numbers specified in the "Gate, Globe and Check Valves Schedule" shown in this Section, are those of Crane Co. for cast steel valves (2 1/2 inches and larger) and Smith Valve Corp. for forged steel valves (2 inches and smaller).

E. Subject to compliance with requirements of this Section, valves shall be one of the following manufacturers, or approved equal:

1. Cast Steel Valves

   Crane Co.

   Walworth Co.

   Powell (William) Co.

2. Forged Steel Valves

   Smith Valve Corp.

   Vogt (Henry) Machine Co. Inc.

GATE, GLOBE AND CHECK VALVES (2-1/2 INCHES AND LARGER) SCHEDULE				
Type	Fig. No.	Ends	Rating Class	Construction Features
Gate	47	FL	150	Compliance with ANSI B16.34
	47-1/2	BW	150	Gates & Globes: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and discs, flexible wedge (for gate) and plug type (for globe) disc Checks: Renewable seats and discs, bolted bonnet.
Globe	143	FL	150	
	143-1/2	BW	150	Materials: Body & bonnet – Cast Steel, ASTM A216 Gr. WCB
Swing Check	147	FL	150	
	147-1/2	BW	150	Stem – 11-14 Chrome, ASTM A182 F6 heat treated
				Seat & Backseat Facing – Ferritic or austentic base metal stellite face
				Disc Facing - 11-14 Chrome, ASTM A 182 F6 heat treated

GATE, GLOBE AND CHECK VALVES (2 INCHES AND SMALLER) SCHEDULE				
Type	Fig. No.	Ends	Rating Class	Construction Features
Gate	888W	SW	600	Compliance with MSS SP-84
Globe	G80W	SW	600	Gates & Globes: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and wedges
Lift Check	C80W	SW	600	
				Checks: Renewable seats and discs, bolted bonnet
				Materials: Body & Bonnet - Forged steel, ASTM A 105 Stem and Disc - 11-14 Chrome, ASTM A 182 F6 heat treated Seat - Base metal stellite

2.03 FUEL OIL SPECIALTIES

Provide the following fuel oil specialties where shown on the Contract Drawings:

A. Fuel Oil Foot Valves

Bronze body, integral intake strainer, single poppet, screwed ends, Preferred Utilities Fig. No. 932 and 918; or approved equal.

B. Pressure Relief Valves

Bronze body, steel spring, 300 psi w.o.g. rating, adjustable pressure settings, screwed ends, Preferred Utilities Type R; or approved equal.

C. Pressure Regulating Valves

Bronze body, steel spindle end spring, 300 psi w.o.g. rating, screwed ends, Preferred Utilities Model BQ; or approved equal.

D. Duplex Strainers

Cast iron body, brass strainer baskets with 3/64 inch perforations, quick-opening covers with airtight seals, switching handles, Preferred Utilities Fig. No. 50; or approved equal.

2.04 ACCESSORIES

A. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of the flow. Sets shall be provided in quantities sufficient to accommodate the installation requirements of 3.04 A of this Section.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2 1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A 13.1.

c. Adhesive bands shall be W.H. Brady Co. "Quick-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high on the upper line, and valve number shall be 1/2-inch high on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

d. Valve tags and the frames for the valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

B. Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors shall be furnished and installed under other Sections.

2.05 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Hangers and supports shall include guides, anchors, stops, restraints, welded attachments, insulation saddles, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hanger and supports.

C. All hangars and supports shall conform to requirements of MSS SP-58 and SP-69.

D. Structural members required for suspended loads shall be shop fabricated for bolting to building structural members.

E. Do not hang piping from other piping. In no case shall hangers be supported by means of vertical expansion bolts.

F. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

G. Support riser piping independently from the connected horizontal piping.

H. Pipe support attachments to the riser piping shall be riser clamp lugs at each floor level.

I. Provide pipe anchors where shown on the Contract Drawings and where necessary to restrain forces due to thermal expansion and contraction of pipe.

J. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

K. Unless otherwise specifically approved, hanger size and spacing shall be as follows:

1. Steel Piping

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/2" to 3-1/2"	9 ft. o.c.	1/2"
4" to 6"	14 ft. o.c.	3/4"
8" to 12"	19 ft. o.c.	7/8"

2. Copper Tubing

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/4" to 2"	7 ft. o.c.	3/8"
2-1/2" to 3"	9 ft. o.c.	1/2"
3-1/2" to 4"	11 ft. o.c.	5/8"

L. All hangers and supports shall comply with the requirements specified under the Section entitled "VIBRATION ISOLATION AND CONTROL".

M. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hangar Co. Inc., or approved equal.

2.06 SLEEVES, SEALS, AND ESCUTCHEONS

A. Pipe Penetration through Walls, Partitions and Floors

1. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

2. Sleeves through concrete floors for piping shall have the opening 1/2-inch in diameter larger than the diameter of the pipe passing through. Floor sleeves shall project one inch above floor slab.

3. Pack the annular space between the pipe and sleeve with mineral wool. Additionally at penetrations through fire-rated barriers, seal the annular space to retain the fire rating integrity of the barrier with non-hardening through-penetration firestops having F-ratings compatible with fire ratings of the barriers in which they are installed, per ASTM, E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio-fireshield, Inc., General Electric Co., Dow Corning Corp., or approved equal.

4. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

B. Pipe Penetration through Exterior Foundation and Pit Walls

1. General

a. All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with the pipe sleeves and seals as shown on the Contract Drawings;

b. Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

2. Lead-Oakum Seals

Where "Lead-Oakum" seals are shown on the Contract Drawings, the annular space between the pipe and the sleeve shall be made watertight by caulking with oakum and poured lead, edged and trimmed.

3. Interlocking Modular Seals (Link-Seal)

a. Where "Link-Seal" is shown on the Contract Drawings, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide a watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

b. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe and seal to ensure a watertight joint. If pipe outside diameter is nonstandard due to coating or insulation, consult the manufacturer for recommendations before proceeding with wall sleeve sizing.

c. Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

d. Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Contract Drawings. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Contract Drawings.

e. Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

2.07 UNDERGROUND FUEL OIL PIPE LEAK DETECTION SYSTEM

A. Provide a complete leak detection system to automatically detect and locate the presence of leaked fuel oil and/or underground water at any point along the secondary (containment) pipe of the fuel oil piping system. The leak detection system shall include electronic control module, fuel/water sensing cable, graphic display panel, and all auxiliary equipment, accessories and appurtenances necessary to make the system complete and operable.

B. The system shall sound audible and visual alarms and locate the event with a digital display to within approximately one foot.

C. The system shall have uniform sensitivity throughout the length of the sensing cable. No more than one (1) foot of leaked fluid in contact with the cable, at a depth of 1/8-inch shall be required to actuate the audible and visual alarms.

D. The system shall operate in such a manner that the presence of a leak cannot be suppressed or otherwise ignored once it is detected. However, it shall be possible to silence the audible alarm after acknowledgement; but the visual alarm shall be maintained until the leak has been corrected.

E. The system shall be UL listed and FM approved.

F. The system shall be tested to Third Party Procedures developed according to the US EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid Phase Out of Tank Product Detectors."

G. The electronic control module shall be capable of monitoring the entire length of the sensing cable(s). It shall continuously monitor the sensing cable for fuel and/or water contact. Contact with any fuel/water shall result in visual/audible alarms, a "leak" LED signal, actuation of an output relay, and a digital display of the location of the point of contact.

H. The electronic control module shall monitor the sensing cable and interconnecting cable for continuity. Any break in the cables shall result in an audible alarm and a "continuity" LED signal, and shall actuate the output relay.

I. The electronic control module shall provide the following additional features:

1. An "events history log" which shall allow events (leaks) to be tracked, if not responded to immediately. A password shall be required to access the log for modifications or erasure.
2. Ability to customize user settings, such as choice of units, use and update of passwords, modifying the re-alarm intervals, etc.
3. Nonvolatile memory to hold the events history log and user settings.
4. Provisions for connection to building management and control system.

J. Control module power requirements shall be 120 Vac, 240 Vac or 24 Vac/Vdc, single phase, 60Hz, as indicated on the Contract Drawings.

K. The electronic control module shall require no operator programming, and shall be capable of automatically calibrating the entire system whenever power is applied.

L. The fuel sensing cable shall detect the presence of fuel oil and other hydrocarbons, as well as water; and shall be capable of accommodating any number of branches using the system's branching connectors.

M. Provide jumper cable as required to interconnect sensing cables, or for remote mounting of the electronic panel, without reducing the maximum amount of sensor cable that the electronic panel is capable of monitoring.

N. Provide a portable test box to permit field inspection and testing of the complete system or portions thereof.

O. The fuel oil leak detection system shall be the product of Raychem Corporation, Trace Tek Products Group; or PermAlert, Subsidiary of Perma-Pipe, Inc.; or approved equal.

PART 3. EXECUTION

3.01 PRE-INSTALLATION INSPECTION

A. Fully inspect FRP pipe for damage. Locate, cut out or replace damaged pipe.

B. Contractor shall complete items A thru E of checklist FPTPI-P8/89 and obtain the Engineer's initials where required.

3.02 INSTALLATION

A. Install piping system in accordance with manufacturers' installation procedures, requirements of NFPA 31 and applicable codes, and as specified.

B. Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry work to avoid necessity of cutting finished structure.

C. The piping layouts shown on the Contract Drawings shall be considered as diagrammatic. Install piping suitable in every respect for the Work intended and clearances required.

D. Run exposed piping perpendicular and parallel to walls and floors.

E. Install all valves and specialties to permit easy operation and ready access for maintenance and repair.

F. Install an isolation gate valve at each branch connection to supply mains and elsewhere as indicated on Contract Drawings.

G. Install drain valves at low points and vents at high points in mains, risers, branch lines, and elsewhere as required for system drainage and venting.

H. Installation requirements for hangers and supports and for pipe penetration sleeves, seals and escutcheons are specified in 2.05 and 2.06, respectively.

I. Glass Fiber Reinforced Epoxy Pipe

1. Install all glass fiber reinforced epoxy piping in compliance with requirements/recommendation of the manufacturer.

2. Unless otherwise indicated on the Contract Drawings, install the underground piping in a compacted, fine sand bedding. Bedding shall be free of clay or sharp gravel.

3. Flanged valves in glass fiber piping shall be flat face or raised face, with spacer or backer rings provided for the mating glass fiber flange.

4. Transitioning from glass fiber pipe to steel pipe shall be accomplished after termination of the secondary (containment) pipe aboveground, immediately after exiting the ground. It shall be achieved by means of flanged joints for pipe sizes 2 1/2-inch and larger, and via glass fiber adaptors (bell x female NPT) for pipe sizes 2-inch and smaller.

5. Valves, strainers and all other fuel oil system components shall be supported independently of the glass fiber pipes.

6. Glass fiber piping shall be supported/restrained, as required, at all changes in direction and at all branches.

7. Secondary containment piping shall be sealed only after primary piping passes inspection and hydrostatic testing.

J. Steel Pipe

1. All steel pipe shall be welded unless otherwise shown on the Contract Drawings.

2. Each welder shall be certified in accordance with ASME Section IX.

K. Copper Tubing

Joints shall be silver soldering.

L. Glass Fiber Pipe Fuel Oil Leak Detection System

1. It shall be Contractor's responsibility to coordinate the installation of the glass fiber fuel oil piping system specified herein in this Section with the installation of the fuel oil leak detection system serving that system.

2. The piping installer shall provide a clean and dry secondary (containment) piping system with free-running pull ropes and adequate clearances to install the sensing cable system.

3. The fuel oil leak detection system shall be installed in accordance with system manufacturer's installation instructions/procedures. Installation shall include, but shall not be limited to functional testing of the system and mapping thereof.

3.03 FIELD TESTS

A. Glass fiber reinforced epoxy pipe shall be hydrostatically tested in accordance with the manufacturer's recommendations.

B. Steel piping from the pump discharge to the oil burner connection shall be hydrostatically tested at 200 psi, for a period of two hours. All equipment controls and instruments shall be isolated from the piping system during the test.

C. Fuel Oil Leak Detection System:

1. Upon completion of the fuel oil leak detection system installation, a factory-furnished fuel sensing cable, of a length established by the system manufacturer, shall be temporarily installed at the far end of the leak detection circuit. One foot of the fuel sensor shall be immersed in a trough containing fuel oil, to a depth of 1/8-inch, to confirm that an alarm is generated and the location thereof is identified on the control module. The procedure shall be repeated utilizing water. The test shall be performed and certified in the presence of Engineer.

2. Upon completion of the test and removal of the temporary test section, the containment piping system shall be sealed.

3. A graphic display map, prepared from "as-built" drawings, shall be furnished upon completion of the test. The map shall indicate the location of the permanent sensor cable and landmarks such as equipment, piping access parts, changes in cable direction, and cable distance readings.

4. Provide qualified technical representatives of the system's manufacturer to instruct and train Authority personnel in the operation and maintenance of the leak detection system for a minimum of 8 hours.

D. Prior to backfilling pipe trench, primary piping system shall be hydrostatically tested to either 150% of working pressure or 50 psig for 30 minutes. All piping found leaking shall be repaired or replaced. After test has been completed, maintain 25 psig pressure on primary piping and monitor pressure loss while installing secondary containment piping. Secondary containment piping shall be pneumatically tested with soap at 5 psig for 30 minutes upon completion. Make repairs as required if pressure loss occurs for either piping system.

3.04 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Contract Drawings. Painting shall be in accordance with the requirements of Section entitled "PAINTING".

3.05 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.04 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system. At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained.

B. Valve Tags

Securely fasten valve tags specified in 2.04 A.2 with approved brass chain.

END OF SECTION

SECTION 15503

FUEL OIL PIPING AND APPURTENANCES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15503A01 a. Piping layout drawings (minimum 1/4"=1'-0" scale) including, at a minimum, hangers, support locations, and details.
b. Piping coordination drawings (minimum 1/4"=1'-0" scale), showing plan views, sections, and piping elevations, on which all items are shown and coordinated with all Work of other Sections.

Product Data

15503D01 a. Pipe material and schedule for each piping system
b. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at aminimum:
1. Fittings and flanges.
2. Hangers and supports.
3. Sleeves, seals and escutcheons.
4. Pipe identification bands.
5. Fuel oil leak detection system and components.
6. Fuel oil leak detection system control schematic, including power/control wiring diagram(s) and graphic display map.

15503D02 a. Catalog cuts, including product performance data, for all items furnished under this Contract, including the following at aminimum:
1. Valves, valve operators and strainers.
2. Valve tags.
b. Valve charts and schedules.

Construction and Installation Procedures

15503G01 "Fiberglass Piping Systems Installation Checklist for Underground Petroleum Pipe", published by the Fiberglass Petroleum Tank & Piping Institute.

15503G02 Field test procedures.

Manuals, Warrantees/Guarantees

15503I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s).

Inspection Reports

15503O01 Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15527

FLOW METERS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for flow meters.

1.01 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME) American Society for Testing and Materials (ASTM)

Instrument Society of America (ISA)

National Electrical Manufacturers Association (NEMA)

In addition, specific provisions cited herein shall govern for the associated specific application.

A. All flow meters shall have an accuracy as specified in 2.01.

1.02 QUALITY ASSURANCE

A. Flow meters of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.03 DELIVERY, STORAGE, AND HANDLING

A. All flow meters shall be factory-cleaned, wrapped and packaged in boxes prior to shipping to construction site.

B. Store flow meters in original packaging in clean, dry spaces and protect them from weather.

C. Prior to installation, inspect flow meters for damage.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES

A. In-Line Turbine Flow Meters

1. General

Type:	In-line, turbine flow meter with magnetic pick-up, and with converter/transmitter
Accuracy:	0.25% over 10:1 flow range
Repeatability:	+ 0.1% of flow rate or better
Max. Press. Drop:	6 psi at rated flow
Temperature Range:	0 to 300 degrees F
Pressure Range:	0 to 300 psi
Housing Body:	316 stainless steel
Rotor Assembly:	17-4 PH stainless steel
Bearings:	Ceramic (Aluminum Oxide)
Connections:	316 stainless steel flanges, ANSI B16.5, Class as shown on the Contract Drawings
Flow Range:	As shown on the Contract Drawings

2. Electronic Unit

Cabinet:	NEMA, Class 1
Power:	115-volt AC, 50-60 Hz
Readouts:	Rate of flow in gpm. Programmable totalizer in gallons

In-line turbine flow meters shall be Fischer & Porter Turbine Flow meters, Series 10C 1516 with integral magnetic pickoff coil and preamplifier; or approved equal.

B. Pressure Differential Flow Meters

1. General

Type:	Universal venturi tube, with flow transmitter and indicating recorder
Accuracy:	0.5% at design flow
Beta Ratio:	0.6
Discharge	Coefficient:0.98
Maximum Head Loss:	8% of differential
Temperature Range:	0 to 400 degrees F
Pressure Range:	0 to 300 psi

2. Venturi Tube

Body:	ASTM A 126, Gr. B, with bronze throat
Size:	Full line size as shown on the Contract Drawings
End Connections:	As shown on the Contract Drawings
Inlet Section:	2-vena contraction, minimum
Throat Length:	0.5 throat diameter, minimum
Outlet Section:	10 degrees diverging cone

3. Flow Transmitter

U8	Electronic 2-wire type, operating on differential capacitance, with local LCD indicator which shall indicate flow in engineering units (gpm)
Housing:	Cast copper aluminum alloy, NEMA 4, anodized and finished with aliphatic urethane
Signal Output:	4-20 ma DC into 540 ohms
Accuracy:	0.25% of full span
Temperature Limits: Minus (-)32 to 180 degrees F ambient; 250 degrees F for barrier diaphragm	
Accessory:	316 stainless steel, 3-valved manifold

4. Indicating Recorder

Recorder Case:	NEMA 1 enclosure
Components:	Front mounted circular chart and pen, indicator scale and totalizer
Signal Input:	DC current, pulse duration or voltage signal
Power Supply:	110-volt, single-phase, 60 Hz, with switch and fuse
Chart Size:	12-inch diameter, 7 days
Indicator Scale:	10-inch long
Totalizer:	Electronic, 7 digit resettable via a password
Pen:	Felt tip with 4-20 ma DC input
Accuracy:	0.5% of full span

Pressure differential flow meters shall be General Signal Corp./BIF Model 181 Universal Venturi Tube with Leeds & Northrup Model 210 Electronic Indicating Recorder and Leeds & Northrup Model IPT-4000 Electronic pressure differential Flow Transmitter; or approved equal.

2.02 SHOP PAINTING

A. In-Line Turbine Flow Meters

Apply epoxy paint to the meter housing, pickup coil and amplifier case.

B. Pressure Differential Flow Meters

1. Apply coal tar paint to the venturi tube.
2. Apply epoxy paint to the cases of the flow transmitter and indicating recorder.

2.03 SHOP TESTS

All flow meters shall be factory calibrated and tested for the accuracy specified in 2.01.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install flow meters in accordance with the manufacturer's installation requirements and procedures and requirements of ANSI B31.1 or B31.9, as applicable.

B. Calibrate meters according to manufacturer's written instruction after installation.

C. Clean all factory-finished surfaces. Repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 15527

FLOW METERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

15527D01 a. Product data including, but not limited to, measurement range, calibrated performance curve, outlines and dimensions of selected models, and required clearances.
b. Components, materials and assembly details.
c. Rated capacity and performance data.
d. Catalog cuts.
e. Manufacturer's calibration certificates for flow meters.
f. Electrical wiring diagrams for power supply and controls.
g. Installation procedures.

Manuals, Warrantees/Guarantees

15527I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawing and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operation, test results, electrical/control devices and electrical/control wiring diagram(s).

END OF APPENDIX "A"

DIVISION 15

SECTION 15705

HVAC EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. Section Includes:

1. Heating, ventilating, and cooling equipment.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 1 - General Provisions.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Air Movement and Control Association (AMCA).
2. Air Conditioning and Refrigeration Institute (ARI).
3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
   a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
   b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
   c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
4. Canadian Standards Association (CSA).
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
7. National Roofing Contractors Association (NRCA).
8. Underwriters Laboratories, Inc. (UL):
   a. 507, Standard for Electric Fans.
9. Building code:
   a. International Code Council (ICC):

(1) International Building Code and associated standards, 2012 Mock-Ups:

B. Miscellaneous:

1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.

2. Corrosion protection of equipment to be as specified herein.

1.03 SUBMITTALS

a. See Appendix A

PART 2. PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Vibration isolation assemblies:

a. Mason.

b. Vibration Mounting and Controls Co.

c. Or approved equal.

2. Corrosion-protective coatings:

a. Heresite and Chemical Co.; "Heresite."

b. Technical Coating Division of Southern Anodizing Co., Inc.; "Technicoat."

c. Or approved equal.

3. Unit heater - electric:

a. ILG Industries, Inc.

b. Brasch.

c. Chromalox.

d. Or approved equal.

4. Wall-mounted propeller-type exhaust fans:

a. Loren Cook.

b. Aerovent.

c. Penn Ventilator Co., Inc.

d. Or approved equal.

5. VRV (Variable Refrigerant Volume) system

a. Daikin-mcquay

b. LG

c. Mitsubishi

d. Or approved equal

2.02 GENERAL

A. All Manufactured Units:

1. Factory wired and assembled.
2. Use fasteners made of same material as unit.
3. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
   a. Type: As per Table 47, Chapter 48, 2011 ASHRAE HVAC Applications Handbook.

B. Indicated manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.

1. Type:
   a. Corrosion-resistant materials:
      (1) Aluminum.
      (2) Stainless steel.
      (3) FRP.
   b. Corrosion-resistant coating:
      (1) Phenolic-based coating:
      (2) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DegF.
      (3) 5 mil baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DegF.
      (4) Factory applied.
      (5) Provide factory certification of application.

2.03 MANUFACTURED UNITS

1. Heating coil - electric:
   a. ARI certified.
   b. 80-percent nickel, 20-percent chromium elements.
   c. Maximum heating density: 35 watts/SQ IN.
   d. Built-in thermal protection.
   e. Airflow switch.
   f. Built-in circuit fusing.
   g. Control voltage transformer.
   h. Terminal block.

i. Magnetic contactor.

j. Fused disconnect switch.

k. Step controller as required by instrumentation.

l. Single point electrical connection.

m. Size and capacity as scheduled on Drawings.

B. Unit Heater - Electric:

1. Type: Horizontal.

2. UL listed for non-rated areas.

3. Material:

a. Cabinet: 18 GA steel.

b. Heating elements: Copper-clad steel.

4. Fan motors:

a. Built-in automatic reset overload protection.

5. Dynamically balanced fan.

6. Built-in automatic reset cutout protection.

7. Accessories:

a. Mounting bracket.

b. 40 to 90 DegF, 5 DegF differential wall-mounted thermostat.

8. Electrical, fan motor, and airflow data as scheduled on Drawings.

2.04. Wall-Mounted Propeller-Type Exhaust Fans:

A. AMCA certified.

B. Industrial quality.

C. Materials:

1. Propeller: Cast aluminum or aluminum.

2. Venturi: Spun aluminum.

3. Panel and supports: Aluminum or stainless steel.

4. Drive shaft: Solid stainless steel.

5. Sheaves: Cast iron.

D. Propellers:

1. Statically and dynamically balanced.

2. Airfoil design.

3. Minimum four (4) blades.

E. Sealed pillow block bearings.

F. Welded reinforced motor base plate.

G. Adjustable motor base.

H. Motor:

1. Driver and driven sheaves:

a. Keyed hub type.

b. Drive sheaves: Fixed pitch diameter.

c. Driver:

(1) Shipped with variable pitch diameter sheave.

(2) Fixed pitch diameter size based on approved test and balance reports.

d. V-belt drives sized for 150 percent motor horsepower.

I. Accessories:

1. Inlet guard.

2. Heavy-duty automatic shutter.

3. Mounting adapter.

4. Bird screen.

J. Size and capacity as scheduled on Drawings.

2.05 VRV (Variable Refrigerant Volume) System

A. Outdoor Unit

1. Modular in Design and can be installed side by side

2. Compressor is high efficiency hermetic scroll type equipped with inverter control capable of changing speed in accordance to cooling or heating load requirement. Unit shall also have multi step control

3. Heat Exchanger shall be copper tubes mechanical bonded to aluminum fins to form cross fin coil. Aluminum fins shall have anti-corrosion resin film.

4. Refrigeration circuit includes liquid and gas shut off valves and a solenoid valve. The following safety devices are provided as part of the outdoor unit:

a. High pressure switch

b. Fan Driver overload protection

c. Inverter overload protector

d. Fusible plugs

e. Fuse.

5. Unit shall be equipped with oil recovery system to ensure stable operation with long refrigerant runs.

B. Indoor Unit

1. Fan shall be dual suction multi blade type that is statically and dynamically balanced for low noise and no vibration.
2. Indoor units shall be ceiling mounted cassette type and wall mounted type.
3. Unit control shall be set by centralized controller.

C. Control

1. A multifunction centralized controller shall be provided to control each zone individually.
2. Unit shall have the ability to set temperature, turn unit on and off.
3. Controller shall have wide screen LCD and can by wired by a non polar two wire transmission cable to a distance of 1 km away from the indoor unit.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install equipment according to manufacturer's recommendations and instructions.

B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

3.02 FIELD QUALITY CONTROL

A. Comply with Specification Section 15992 for balancing requirements.

END OF SECTION

SECTION 15705

HVAC EQUIPMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings / Product Data / Catalog Cuts

a. Details of equipment construction components, dimensions of selected models, materials, gauges, finishes, weights, load distribution, required clearances and locations and sizes of field connections.

b. Equipment schedules.

c. Certified performance operating curves for pressure-volume relation for each piece of equipment.

d. Certified sound power levels at rated capacity at each octave band.

e. Catalog cuts of equipment, specialties, accessories and other items specified in this Section.

f. Specialties and accessories.

g. Electrical wiring diagrams for power supply, interlock and controls.

h. Motor and electrical operating data.

i. Belt drive construction and rating.

j. Installation procedures.

k. Shop test results.

B. Operation and Maintenance Manuals

1. Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s), bearings maintenance procedures, lubrication procedures and lubricant type.

C. Construction and Installation Procedures

1. Field test procedures.

D. Site Inspection Reports

1. Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15731

COMPUTER ROOM AIR CONDITIONING UNIT

PART 1. GENERAL

1.01 Summary

A. Furnish all labor, materials, tools, equipment, and services for Computer Room Air Conditioning Unit, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.02 Submittals

1. See Appendix A.

PART 2. PRODUCTS

2.01 Acceptable Manufacturers

A. Computer room air conditioning unit:

a. Liebert.

b. Data-Aire.

c. Or approved equal.

B. Other manufacturers desiring approval comply with Division 1.

2.02 Materials

A. Computer room air conditioning unit: Self-contained factory assembled unit.

1. Discharge air flow pattern: Up.

2. Matching dual refrigeration systems.

a. Air cooled condenser.

3. Design system for draw through air arrangement to insure even air distribution to entire face area of coil.

4. Design to allow control system and electrical circuitry to be serviced and/or checked while system is in operation without disturbing air flow and performance of system.

5. Design compressor section to allow either compressor to be serviced while system is in operation without disturbing performance and/or air flow.

B. Cabinet and frame construction: Frame constructed of heliarc welded tubular steel for maximum strength.

1. Interior sheet metal welded to frame assembly.
2. Exterior panels insulated with minimum 1 IN 1-1/2 PCF density fiber insulation.
3. Provide panels with captive quarter fasteners quickly removable for easy access to equipment.
4. Arrange panels to provide access to electrical control panel and compressor section without interrupting air flow.
5. Factory finish.
6. Colors: Manufacturers standard colors.

C. Evaporator: A-frame design DX coil.

1. Construct of copper tubes and aluminum fins with maximum face velocity of 500 FPM at 6000 CFM to provide maximum sensible cooling.
2. Design refrigeration circuit to distribute refrigerant into entire coil face area from each compressor.
3. Mount entire coil assembly in stainless steel condensate drain pan.

D. Compressors:

1. Digital Scroll refrigeration system, direct expansion with 2 separate refrigeration circuits.
   a. The compressor shall be scroll-type with a variable capacity operation capability. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 3500 RPM
2. Mount compressor on vibration isolators.
3. Provide built in overloads, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication and pump down control.
4. Maximum operating speed: 3500 RPM.
5. Provide in refrigeration circuit: Hot gas mufflers, liquid line filter dryers, refrigerant sight glass and moisture indicator from adjustable externally equalized expansion valves, liquid lines solenoid valves, factory connected with type "L" refrigeration copper tubing.
6. Locate compressors in separate compartment so conditioned air does not flow over them and they may be serviced during operation of equipment.

2.03 Fan:

A. Variable speed, centrifugal type, double width, double inlet, statically and dynamically balanced.

1. Balance at factory as completed assembly to maximum vibration level of 2 mils in any plane.

B. Support wheels on heavy duty steel shaft with self aligning ball bearings with minimum life span of one hundered thousand hours.

C. Drive: 1750 RPM motor mounted on adjustable slide base, 2-belt drive, variable speed, sized for 200 percent of fan motor power.

D. Locate fans to draw air over A-frame coil to ensure even air distribution and maximum coil performance.

2.04 Filter chambers: Integral, designed within frame and cabinet.

A. Filters serviceable from either end of unit without use of ladders or special rigging. Filters shall be deep pleated 4" filters with an ASHRAE 52.2 MERV11 rating.

2.05 SCR Electric Reheat

A. The electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches. The reheat elements shall be removable from the front of the cabinet.

2.06 Humidifier:

A. Infra-red type.

1. *Provide high intensity quartz lamps mounted above and out of water supply.*

B. Evaporator pan: Stainless steel, arranged to be serviceable for cleaning without disconnecting water supply lines, drain lines or electrical connections.

C. Infra-red autoflush system: Field adjustable flush control system to change cycle time in accordance with local water conditions.

1. Ensure primary distilled water supply to infra-red humidifier is from condensate drain pan to eliminate cleaning maintenance.

D. Use bypass air to prevent over-humidification.

2.07 Air cooled condenser: Low profile, variable speed, multiple direct drive propeller fan type.

A. Arrange condenser for vertical air discharge.

B. Two separate refrigeration circuits to balance heat rejection of each compressor.

C. Construct condenser of aluminum with copper tube, aluminum fin coil, with maximum fin spacing of 10 fins per inch.

2.08 Microprocessor Control with Small Graphic Display

A. The unit control shall be factory-set for Intelligent Control, which uses "fuzzy logic" and "expert systems" methods. Proportional and Tunable PID shall also be user-selectable options. Internal unit component control shall include the following:

1. Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.

2. System Auto Restart - The auto restart feature shall automatically restart the system after a power failure. Time delay is programmable.

3. Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

4. Predictive Humidity Control - calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature.

B. The control shall be compatible with all remote monitoring and control devices. Provide BMS interface via BACnet.

C. The control processor shall be microprocessor based with a LCD graphic front monitor display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the unit panels are open or closed. The controls shall be menu-driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.

D. The User Menus Shall be Defined as Follows:

1. Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.

2. Event Log: Unit memory shall hold the 400 most recent events with ID number, time and date stamp for each event.

3. Graphic Data View: Eight graphic records shall be available: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.

4. Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.

5. Total Run Hours: Menu shall display accumulative component operating hours for major components including compressors, fan motor, humidifier and reheat.

6. Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

7. Display Setup: Customer shall pre-select the desired grouping of display languages at the time of the order from the following choices:

   Group 1: English, French, Italian, Spanish, German
   Group 2: English, Russian, Greek
   Group 3: English, Japanese, Chinese, Arabic

8. Service Contacts: Menu shall allow display of local service contact name and phone number.

E. The Service Menus Shall be Defined as Follows:

1. Setpoints: Menu shall allow setpoints within the following ranges:

   a. Temperature Setpoint: 65-85°F (18-29°C)
   b. Temperature Sensitivity: +1-10°F (0.6-5.6°C)
   c. Humidity Setpoint: 20-80% RH*
   d. Humidity Sensitivity: 1-30% RH*
   e. High Temperature Alarm: 35-90°F (2-32°C)
   f. Low Temperature Alarm: 35-90°F (2-32°C)
   g. High Humidity Alarm: 15-85% RH
   h. Low Humidity Alarm: 15-85% RH

F. Standby Settings/Lead-Lag: Menu shall allow planned rotation or emergency rotation of operating and standby unit

G. Timers/Sleep Mode: Menu shall allow various customer settings for turning On/Off unit.

H. Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:

   a. High Temperature
   b. Low Temperature
   c. High Humidity
   d. Low Humidity
   e. Compressor Overload
   f. Main Fan Overload
   g. Humidifier Problem
   h. High Head Pressure
   i. Change Filter
   j. Fan Failure
   k. Low Suction Pressure
   l. Unit Off

I. Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.

J. Common Alarm: A programmable common alarm shall be provided to interface user-selected alarms with a remote alarm device.

K. Remote Monitoring: All alarms shall be communicated to the monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

L. Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.

M. Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.

N. Options Setup: Menu shall provide operation settings for the installed components.

O. System/Network Setup: Menu shall allow Unit-to-Unit (U2U) communication and setup for Teamwork modes of operation (up to 32 units).

P. Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.

Q. Auxiliary Boards: Menu shall allow setup of optional expansion boards.

R. Diagnostics/Service Mode: The control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

S. Advanced Menus

1. Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.
2. Change Passwords: Menu shall allow new passwords to be set or changed.
3. Fan speed winter control system for condenser: Pressure transducer to automatically sense highest pressure of either operating compressor and control variable speed fan on condenser to properly maintain head pressure.
4. Pressure transducers, thermostats and electrical control circuit, factory pre-packaged in fan speed control box.
5. Mount fan speed control box to condenser in field.
6. Provide positive start-up and operation in ambient temperature as low as minus 20 degF.
7. Include solid state winter start kit as integral feature of electronic control panel.
8. Smoke Detector: Mount in electrical panel with sensing element in supply/return air, to immediately shut down air conditioning system when detector is is activated.

2.09 EXECUTION

A. INSTALLATION

1. Install in accordance with manufacturer's instructions and as specified.

B. PERFORMANCE TEST

1. Provide services of a factory trained representative to start and run unit under load for minimum of 8 hours to ensure complete system is operating and performing as specified.

C. THE AUTHORITY INSTRUCTIONS

1. Provide service of manufacturer's representative for minimum of 4 hours, when requested by The Authority, to instruct The Authority's operating personnel.

END OF SECTION

SECTION 15731

COMPUTER ROOM AIR CONDITIONING UNITS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings / Product Data / Catalog Cuts

a. Details of equipment construction components, dimensions of selected models, materials, gauges, finishes, weights, load distribution, required clearances and locations and sizes of field connections.

b. Equipment schedules.

c. Certified performance operating curves for pressure-volume relation for each piece of equipment.

d. Certified sound power levels at rated capacity at each octave band.

e. Catalog cuts of equipment, specialties, accessories and other items specified in this Section.

f. Specialties and accessories.

g. Electrical wiring diagrams for power supply, interlock and controls.

h. Motor and electrical operating data.

i. Belt drive construction and rating.

j. Installation procedures.

k. Shop test results.

B. Operation and Maintenance Manuals

1. Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s), bearings maintenance procedures, lubrication procedures and lubricant type.

C. Construction and Installation Procedures

1. Field test procedures.

D. Site Inspection Reports

1. Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15855

AIR HANDLING UNITS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for packaged air handling units for indoor installation.

B. Types of air handling units specified in this Section are:

Heating, Ventilating and Air-Conditioning (HVAC) Units
Heating and Ventilating (HV) Units

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

Occupational Safety and Health Administration (OSHA)
Anti-Friction Bearing Manufacturers Association (AFBMA)
Air Movement and Control Association (AMCA)
American National Standards Institute (ANSI)
Air-Conditioning and Refrigeration Institute (ARI)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
American Society for Testing and Materials (ASTM)
National Fire Protection Association (NFPA)
National Electrical Manufacturers Association (NEMA)
Steel Structures Painting Council (SSPC)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of air handling units shall be as specified in the Air Handling Unit Schedules (hereinafter in this Section "Schedules"), shown on the Contract Drawings.

1.03 QUALITY ASSURANCE

A. Air handling units, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Air handling units shall be subject to factory inspection prior to shipping.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver units with factory-installed wooden skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle units carefully to avoid damage to components, enclosures, and finish.

C. Store units in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading units, and moving units to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide factory-fabricated air handling units of one of the following manufacturers, or approved equal:

A. Heating, Ventilating and Air-Conditioning Units

Carrier Corp.
McQuay International
York International Corp.

B. Heating and Ventilating Units

Carrier Corp.
McQuay International
York International Corp.

2.02 MATERIALS

Materials for air handling units shall be as specified below.

A. Casing

Panel:	Galvanized or phosphatized steel
Insulation:	3-pound density, neoprene-coated glass fiber board

B. Centrifugal Fans

Wheel:	Steel
Shaft:	Forged steel
Variable Inlet Vanes:	Steel (if indicated on the schedules on the Contract Drawings)

C. Hot Water and Chilled Water Cooling Coils

Tubes:	Copper
Fins:	Aluminum or copper
Header:	Copper
Housing:	Galvanized steel
Tube Supports:	Galvanized steel

D. Direct Expansion Cooling Coils

Tubes:	Copper
Fins:	Aluminum or copper
Distributor::	Copper
Return Header:	Copper
Housing:	Galvanized steel
Tube Supports:	Galvanized steel

E. Non-Freeze Steam Heating Coils

Outer Tubes:	Copper
Inner Tubes:	Copper
Fins:	Aluminum or copper
Header:	Steel
Housing:	Galvanized steel
Tube Supports:	Galvanized steel

F. Filters

Filter Housing:	Galvanized steel
Replaceable Filters:	Blend of synthetic fibers or fiberglass (panel and bag)
Cleanable Filters:	Layers of corrugated wire mesh
Roll Filters:	Fiberglass

G. Drain Pans

Outer Pan:	Galvanized steel
Inner Pan:	Stainless steel liner

H. Electric Resistance Heating Coils

1. Open-Wire Type

Resistance Wires:	80 percent nickel/20 percent
Insulating Bushings:	Ceramic
Support Frame:	Aluminized or galvanized

2. Finned-Tubular Type

Resistance Wires:	80 percent nickel/20 percent
Element Holding Tubes:	Copper-plated steel
Insulating Filler Powder:	Magnesium oxide

Fins:	Copper-plated steel
Support Frame:	Aluminized or galvanized

I. Face and Bypass Dampers

Blades:	Galvanized steel
Operating Rods:	Steel
Bearings:	Bronze or nylon
Frame:	Galvanized steel

2.03 CONSTRUCTION FEATURES

A. General

1. Air handling units shall be of sizes, arrangements and capacities specified in the Schedules and as shown on the Contract Drawings.

2. HVAC units shall consist of casing, centrifugal fan, coils, filters, drain pan, mixing box, motor drive and accessories specified in the Schedules, shown on the Contract Drawings and specified herein.

3. Heating and ventilating units shall consist of casing, centrifugal fan, heating coils, filters, mixing box, face and bypass dampers, motor drive and accessories specified in the Schedules, shown on the Contract Drawings and specified herein.

B. Casings

1. Provide casings with reinforced and braced structural frame having sectionalized, removable panels on both sides of all coils, filters, and fans.

2. For HVAC units, apply insulation on the inside surface of all parts of the units, meeting requirements of the applicable energy conservation codes. However, as a minimum, apply one-inch thick insulation on inside of the entire fan and coil section with waterproof adhesive and permanent fasteners. Insulation shall meet NFPA 90A flame spread and smoke generation requirements.

3. Provide hinged, gasketed and latchable fully-insulated, double wall access doors on opposite sides of casings, at the following locations:

   a. Fan section.

   b. Air inlet and discharge of each coil.

   c. Air inlet and discharge of filter section.

4. Access doors shall have a full perimeter automotive type gasket to prevent air leakage. They shall be openable from unit interior.

   Direction of door opening shall be inward on pressure side and outward on suction side. Doors shall be minimum 12 inches long in direction of air flow and full height of the unit excluding framing.

5. Provide casings with lifting lugs, test connections, and taps for thermometers and pressure gauges.

C. Centrifugal Fans

1. Fans shall consist of housing, wheel, shaft, bearings, and support structure.

2. Provide curved scroll housing, with lockseam construction or continuous welding construction. Provide spun inlet cones and duct connections.

3. Provide forward-inclined, backward-inclined or backward-inclined airfoil blades. Weld blades to wheel rim and hub plate; key wheel to shafts. Wheel diameter and outlet areas shall be in accordance with AMCA Standard 99 for non-overloading fans.

4. Provide solid, accurately turned, ground and polished shafts.

5. Provide grease-lubricated, precision anti-friction ball or roller, self-aligning, pillow block type bearings to provide median (l-50) life rating of 200,000 hours in accordance with AFBMA Std. 9 for ball bearings or AFBMA Std. 11 for roller bearings. Bearings shall be equipped with grease fittings and extended grease lines to allow lubrication from one side of the fan.

6. Provide multiple matched V-belt drive with minimum 1.4 times rated motor horsepower. Provide adjustable pitch sheave on motor shaft, selected for midpoint at design conditions.

7. Provide access door in scroll housing, with latch-type handles, flush mounted.

8. Before shipment, fans shall be statically and dynamically balanced.

9. Provide ventilated belt guards with tachometer opening for fan speed measurements, on all units, in accordance with OSHA requirements.

10. Where specified in the Schedules shown on the Contract Drawings, provide fans with variable inlet vanes integral with the inlet bells of the fan. Connect vane rods to control ring by crank arms; provide vane rods supported at both ends by nylon bearings. Both sets of vanes shall be operated by a lever on the fan scroll with connecting shaft between inlets. Vane linkage shall be suitable for either manual or automatic operation.

D. Hot Water and Chilled Water Cooling Coils

1. Water coils shall consist of a single or multiple coils, as shown on the Contract Drawings. Mount and arrange components to permit expansion without strain on tubes, headers or casing, and with all guides and supports necessary to ensure proper alignment and unimpaired drainage. Mount coils on the steel frame of the air-handling unit. Coils shall be removable from coil's connection side, unless indicated otherwise on the Contract Drawings, without dismantling or unbolting any component of the unit, other than the coil section access panel.

2. Enclose coil headers completely within the insulated coil section casing. Extend the inlet and outlet connections a minimum of six inches beyond the exterior of the coil casing through pre-cut openings. Provide sealing collars at the openings for the coil connections. All coils must have some end connections regardless of the number of rows deep.

3. Do not space fins closer than eight fins per inch and bond fins mechanically to the tubes.

4. Coils shall be of serpentine, staggered, continuous tube, multiple row, water type and shall have non-trapping circuits. Coil tube outside diameter shall be 5/8 inch with a wall thickness not less than 0.025 inch. Ensure that water velocity does not exceed 7 fps.

5. Coils shall be completely drainable by gravity through the supply header. Provide drain and vent connections for each coil with the connections external to the unit for ease of access.

6. Coils shall be rigidly supported across the full face of coil. Provide intermediate tube sheet supports for all coils exceeding 54 inches in length or less as is necessary to ensure rigid coil support.

7. Provide cooling coils with drain troughs between stacked coils, and run drain lines from the trangles to the drain pan.

E. Direct Expansion Cooling Coils

1. Direct expansion-cooling coils shall consist of single or multiple coils assembled for horizontal or vertical air flow, as shown on the Contract Drawings. Coils shall be suitable for use with a continuously circulating refrigerant specified in the Schedules shown on the Contract Drawings.

2. Cooling coils shall be cartridge type, removable from coil connection side of casing and supported in tracks over the entire length of the coil.

3. Each coil shall be of serpentine, staggered, continuous tube, multiple row, refrigerant type. Coil tube outside diameter shall be 5/8 inch with a wall thickness not less than 0.025 inch. Provide each coil with a maximum of 12 circuits per distributor. Coils with more than 12 circuits, and split-circuit coils shall have two distributors.

4. Fins shall be plate or spiral type. Do not space fins closer than 12 fins per inch and bond fins mechanically to the tube.

5. Locate coil inlet and outlet connections on the same end of the coils.

6. Coils shall be rigidly supported across the full face of the coil. Provide tube supports at a maximum spacing of 42 inches, or less as is necessary to ensure rigid coil support.

7. Frame and support multiple coil banks so that individual coil removal is readily possible without removal of other coils in a bank. Coil tubes shall be free to expand and contract. Arrange coils within the coil casing so that refrigerant flow shall be counterflow to air flow for coils with more than a single row.

8. Provide coils with drain troughs between stacked coils, and run drain lines from the troughs to the drain pan.

F. Non-Freeze Steam Heating Coils

1. Non-freeze steam heating coils shall consist of single or multiple coils as shown on the Contract Drawings.

2. Heating coils shall be cartridge type, removable from coil connection side of casing and supported in tracks over the entire length of the coil.

3. Each heating coil shall be continuous tube, non-freeze distributing (tube within a tube), one or two row, steam type. Coil tube outside diameter shall be minimum one inch with 5/8-inch inner distributing tube. Tube wall thickness shall be not less than 0.025 inch.

4. Fins shall be plate type. Do not space fins closer than 10 fins per inch and bond fins mechanically to the tube.

5. Locate coil inlet and outlet connections on the same end of the coils.

6. Coils shall be rigidly supported across the full face of the coil. Provide tube supports at maximum spacing of 42 inches, or less as is necessary for rigid coil support.

7. Frame and support multiple heating coil banks so that individual coil removal is readily possible without removal of other coils in a bank. Coil tubes shall be free to expand and contract. Arrange coils within the coil casing so that steam flow shall be counterflow to air flow for two-row heating coils.

8. Heating coils shall be drainable.

9. Provide for even air temperature leaving the coil without stratification. At coil loads from 20% to 100% of full capacity, variations between maximum and minimum air temperature leaving the coil, measured at any point across the coil face shall not exceed 4 degrees F.

G. Electric Resistance Heating Coils

1. If specified in the Schedules shown on the Contract Drawings, the electric resistance heating coil shall be the open-wire type. It shall be in compliance with the National Electrical Code (NEC), and shall be UL listed for zero clearance to combustible surfaces. It shall be rated for the KW, voltage, phase and number of heating stages indicated on the Contract Drawings. The elements shall be uniformly distributed over the cross-sectional area of unit, with vertical support brackets to prevent coil element sag. Coil elements shall be insulated by means of insulating bushings and supported within a steel support frame.

2. If specified in the Schedules shown on the Contract Drawings, the electric resistance heating coil shall be finned-tubular construction. It shall be in compliance with the National Electrical Code (NEC), and shall be UL listed for zero clearance to combustible surfaces. It shall be rated for the KW, voltage phase and number of heating stages indicated on the Contract Drawings. The heating element shall be mounted inside an element tube and surrounded by compacted insulating filler powder. Tubes shall be spirally wound with fins that are continuously brazed to tubes. Coils shall be mounted inside a steel supporting frame.

3. Integral terminal box shall include primary automatic and secondary manual reset thermal protective devices, backup contactors, subcircuit fusing, fused disconnect switches, fan interlock relays, pressure differential air flow switch, fused control transformer and all other safety devices to meet UL and NEC requirements.

H. Face and Bypass Dampers

1. Internal face and bypass dampers shall be of the opposed blade type. Provide all required linkage; lock the blades to damper rods, rotating in rustproof bushings requiring no lubrication.

2. External face and bypass dampers shall consist of bypass dampers of the parallel blade type and face dampers of the opposed blade type. Provide all required linkage; lock the blades to damper rods, rotating in rustproof bushings requiring no lubrication.

I. Mixing Boxes

1. Where indicated on the Contract Drawings, provide mixing boxes with parallel blade damper sets for merging return air and outside air streams inside the box. Damper blade rods shall rotate on rustproof bushings requiring no lubrication.

2. Mixing box frame shall be fabricated and finished in the same manner as the casings.

3. Provide the frame with a flanged connection to match the air handling unit.

J. Filters

1. Filter Housing

a. Filter housing shall be side servicing type and shall be fabricated and finished the same as the casings.

b. Provide the housing with flanged connections on both inlet and outlet, sized to match the air handling unit.

c. Provide integral pre-filter tracks to accommodate two-inch throwaway or cleanable filters.

d. Provide quick-opening, hinged access doors with continuous gasketing on perimeter and positive locking devices.

2. Replaceable Panel Filters

a. Provide throwaway flat panel type air filters with holding frames.

b. Provide viscous-impingement filter media of two-inch thickness. Filter media shall be UL 900 Class rating specified in the Schedules shown on the Contract Drawings.

c. Provide filters with rated face velocity of 500 fpm, initial resistance of not greater than 0.30-inch w.g., final rated resistance of 0.50-inch w.g., and average efficiency not less than 20 percent based on "Determination of Atmosphere Dust Spot Efficiency" of ASHRAE Standard 52.

3. Bag Filters

a. Provide replaceable bag type air filters with holding frames.

b. Provide dry filter media formed into V-shaped pleats and held by self-supporting wire frames. Filter media shall be UL 900 Class rating specified in the Schedules shown on the Contract Drawings.

c. The rated face velocity, initial resistance, final resistance, and average dust spot efficiency shall be not less than the values specified in the Schedules shown on the Contract Drawings.

4. Cleanable Panel Filters

a. Provide cleanable (washable), flat panel type air filters with holding frames.

b. Provide viscous-impingement filter media of two-inch thickness. Filter media shall consist of layers of corrugated wire mesh and shall be UL 900 Class rating specified in the Schedules shown on the Contract Drawings.

c. The rated face velocity, initial resistance, final resistance, and average dust spot efficiency shall be not less than the values specified in the Schedules shown on the Contract Drawings.

5. Automatic Roll Filters

a. Provide automatic, motor-driven, self-renewing roll type air filters with gasketed holding casing.

b. Provide viscous-impingement filter media of two-inch thickness. Filter media shall be glass fiber of progressive density and progressive fiber diameter and shall be UL 900 Class rating specified in the Schedules shown on the Contract Drawings.

c. Provide electrically driven feed control mechanism with pressure differential sensor; provide filter drive with manual media advance and run-out switches for stopping media movement of filter bank and operating remote warning signal lights.

d. The rated face velocity, initial resistance, final resistance, and average dust spot efficiency shall be not less than the values specified in the Schedules shown on the Contract Drawings.

K. Drain Pans

1. Provide a drain pan under the complete fan and cooling coil sections of draw-through HVAC units and the coil and discharge plenum sections of blow-through HVAC units. The drain pan shall be of double floor construction, sandwiching a 1/2-inch polyurethane insulation board between the two layers of metal. Insulation and adhesive shall comply with NFPA No. 90A flame spread and smoke generation requirements. Provide drain pans with 1-1/4-inch IPS minimum size, outlet drain connections on both sides of units.

2. Extend the drain pans a minimum distance beyond the cooling coils equal to at least the finned height of the cooling coil or cooling coil banks, or more as required to capture moisture carry-over from the cooling coils at design conditions. Make provisions to permit free drainage from each section.

3. When two or more cooling coils are used, with one stacked above the other, provide individual drain troughs, piped to the main drain pan, below each of the upper coils.

L. Vibration Isolation

Provide vibration isolation in accordance with requirements specified in the Division 15 Section entitled "VIBRATION ISOLATION AND CONTROL". Consult with the supplier of vibration isolation devices concerning the selection of the types required.

M. Motors

Provide motors in accordance with requirements specified in the Division 15 Section entitled "MOTORS AND MOTOR CONTROLLERS". Motors shall be externally mounted on adjustable bases. Select the motor characteristics, the motor mounting and all accessories necessary to satisfy the requirements of the fan motor drive unit in all operating modes.

2.04 SHOP PAINTING

Fans, casings, and steel fabrication shall be given one coat of zinc chromate primer and one coat of machine enamel on both the exterior and interior surfaces.

2.05 SHOP TESTS

A. Balance fan wheels statically and dynamically, prior to final operating tests with motor and drive in place.

B. Test, rate and certify all coils in accordance with ARI Standard 410; fans shall bear ARI seals.

C. Test, rate and certify all air handling units, as complete units, in accordance with ARI Standard 430; fans shall bear ARI seals.

D. If specified in the Schedules shown on the Contract Drawings, the factory test shall be witnessed by the Engineer. The Contractor shall notify the Engineer 14 days in advance of the scheduling of said factory tests.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install units in accordance with manufacturer's installation procedures.

B. Coordinate all Work to ensure that the installation of the units is not in conflict with the Work specified under other Sections.

C. Verify that electrical wiring installation is in accordance with manufacturer's submittal and in accordance with the installation requirements of Division 16. Ensure that rotation is in direction indicated and intended for proper performance.

3.02 FIELD TESTS

A. Install filters at completion of air handling system work, and prior to equipment startup, testing, adjusting, and balancing.

B. Provide a qualified technical representative of the manufacturer to advise on field tests.

C. Start up, test, and adjust units in presence of the manufacturer's representative.

D. Following testing and adjustments, replace filters with new filters (spare filters) before final inspection by the Engineer.

END OF SECTION

SECTION 15855

AIR HANDLING UNITS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15855A01 a. Unit construction details including components, materials, gauges, dimensions of selected models, required clearances, weights (shipping, installed, and operating), load distribution and location and size of each field connection. Shop drawings shall be at a minimum of 1/4"=1'-0" scale.
b. Air-handling unit schedules.
c. Certified fan performance pressure-volume, horsepower, and efficiency curves, with system operating conditions indicated.
d. Certified fan and compressor sound power levels at rated capacity at each octave band.
e. Certified coil performance ratings with system operating conditions indicated.
f. Filter performance characteristics.
g. Damper performance curves.
h. Catalog cuts.
i. Refrigerant piping diagram.
j. Electrical wiring diagrams for power supply, interlock and controls.
k. Motor ratings and electrical characteristics.
l. Drive construction and rating.
m. Installation procedures.
n. Shop test results.

Construction and Installation Procedures

15855G01 Field test procedures.

Manuals, Warrantees/Guarantees

15855I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawing and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s), bearings maintenance procedures, lubrication procedures and lubricant type.

Inspection Reports

15855O01 Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15860

CENTRIFUGAL FANS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for centrifugal fans.

B. Types of centrifugal fans specified in this Section are:

1. Centrifugal Fans and Utility Sets.
2. Tubular (inline) Fans.
3. Roof Ventilators.
4. Wall Ventilators.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

Air Movement and Control Association (AMCA)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
Anti-Friction Bearing Manufacturers Association (AFBMA)
National Electrical Manufacturers Association (NEMA)
Occupational Safety and Health Administration (OSHA)
Steel Structures Painting Council (SSPC)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of centrifugal fans shall be as specified in the Centrifugal Fan Schedules, (hereinafter in this Section "Schedules") shown on the Contract Drawings.

1.03 QUALITY ASSURANCE

A. Centrifugal fans, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans with factory-installed wooden skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish.

C. Store fans in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading fans, and moving fans to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide fans of one of the following manufacturers, or approved equal:

A. Centrifugal Fans/Utility Sets

Buffalo Forge Co.
New York Blower Co.
Trane Co.
Cook (Loren) Co.

B. Tubular (Inline) Fans

Cook (Loren) Co.
Greenheck Fan Corp.
Penn Ventilator Co., Inc.

C. Roof Ventilators

Penn Ventilator Co., Inc.
Greenheck Fan Corp.
Cook (Loren) Co.

D. Wall Ventilators

Carnes Co., Inc.
Cook (Loren) Co.
Greenheck Fan Corp.

2.02 MATERIALS

Materials for fans shall be as specified below.

A. Centrifugal Fans/Utility Sets

Wheel:	Steel or aluminum
Shaft:	Forged steel
Housing:	Galvanized or coated steel

B. Tubular (Inline) Centrifugal Fans

Wheel:	Aluminum or steel
Shaft:	Forged steel
Housing:	Aluminum, galvanized or coated steel

C. Roof and Wall Ventilators

Wheel:	Aluminum
Shaft:	Forged steel
Housing:	Aluminum

2.03 CONSTRUCTION FEATURES

A. Centrifugal Fans/Utility Sets

1. Fans shall be of sizes, arrangements and capacities specified in the Schedules and as shown on the Contract Drawings.
2. Fans shall consist of housing, wheel, shaft, bearings, motor, and support structure.
3. Provide curved scroll housings, with lockseam construction for fan sizes 36 inches and smaller, and spot welded construction for fan sizes 40 inches and larger. Provide horizontally split housings, bolted together for fan sizes 66 inches and larger. Provide spun inlet cones and duct connections.
4. Provide the types of wheels specified in the Schedules shown on the Contract Drawings. Weld blades to wheel rim and hub plate; key wheel to shafts. Wheel diameter and outlet areas shall be in accordance with AMCA Standard 99 for non-overloading fans.
5. Provide solid, accurately turned, ground and polished shafts.
6. For fan sizes 22 inches and smaller, provide grease-lubricated, precision anti-friction ball or roller, self-aligning, pillow block type bearings to provide minimum L-10 life rating of 60,000 hours in accordance with AFBMA Std. 9 for ball bearings or AFBMA Std. 11 for roller bearings. For fan sizes 24 inches and larger, provide grease-lubricated, tapered double spherical roller, pillow block type bearings to provide minimum L-10 life rating of 120,000 hours in accordance with AFBMA Std. 11. Extend grease lines from bearings to outside of inlet duct flange, and terminate with grease fittings.

7. If "Belt Drive" fans are specified in the Schedules shown on the Contract Drawings, provide multiple matched V-belt drive for motors less than 50hp, and fixed pitch sheave for 50hp motor and larger. V-belt drives to be rated minimum 1.4 times rated motor horsepower. Provide adjustable pitch sheave on motor shaft, selected for midpoint at design conditions.

8. Provide access door in scroll housing, with latch-type handles, flush mounted for uninsulated housings, and raised-mounted to the thickness of insulation for insulated housings.

9. Provide 3/4-inch threaded coupling drain connection with plug at lowest point of the housing.

10. Provide removable flanged screens at inlets or outlets where no connecting ductwork is shown on the Contract Drawings.

11. Provide ventilated belt guards with tachometer opening for fan speed measurements, in accordance with OSHA requirements.

12. If specified in the Schedules shown on the Contract Drawings, provide fans with variable inlet vanes integral with the inlet bells of the fan. Connect vane rods to control ring by crank arms; provide vane rods supported at both ends by non-rusting nylon bearings. For double-inlet fans, both sets of vanes shall be operated by a lever on the fan scroll with connecting shaft between inlets. Vane linkage shall be suitable for either manual or automatic operation.

B. Tubular (Inline) Fans

1. Fans shall be of sizes, arrangements and capacities specified in the Schedules and as shown on the Contract Drawings.

2. Fans shall consist of housing, wheel, shaft, bearings, straightening vanes, and motor support.

3. Provide housings with continuous-weld construction, braced to prevent vibration or pulsation.

4. Provide backward-inclined or airfoil blades, of welded wheel construction. Fan wheel diameter and outlet areas shall be in accordance with AMCA Standard 99 for non-overloading fans.

5. Provide solid, accurately turned, ground and polished shafts.

6. Provide grease-lubricated, precision anti-friction ball or roller, self-aligning, pillow block type bearings to provide minimum L-10 life rating of 40,000 hours in accordance with AFBMA Std. 9 for ball bearings or AFBMA Std. 11 for roller bearings. Extend grease lines from bearings to outside of inlet duct flange, and terminate with grease fittings.

7. If "Belt Drive" fans are specified in the Schedules shown on the Contract Drawings, provide multiple matched V-belt drive for motors less than 50 hp, and fixed pitch sheave for 50 hp and larger. V-belt drives to be rated minimum 1.4 times rated motor horsepower. Provide adjustable pitch sheave on motor shaft, selected for midpoint at design conditions.

8. Provide access door in housing, located over wheel in accessible position, with latch-type handles, flush mounted for uninsulated housing, and raised-mounted to the thickness of insulation for insulated housings.

9. Provide 3/4-inch threaded coupling drain connection with plug at lowest point of housing.

10. Provide heavy mesh, removable screens on fan inlets and outlets where no connecting ductwork is shown on the Contract Drawings.

11. Provide belt guards with tachometer opening for fan speed measurements, in accordance with OSHA requirements.

12. For "Belt Drive" fans, provide inner tube construction to isolate bearings and drive from air stream; provide removable cover for access to bearing and drive.

13. If specified in the Schedules shown on the Contract Drawings, provide variable inlet vanes in fan inlet with a linkage suitable for either manual or automatic operation.

14. If outdoor location is specified in the Schedules shown on the Contract Drawings, provide protective weather hood with ventilation slots over motor and drive compartment.

15. If ceiling-hung fans are specified in the Schedules shown on the Contract Drawings, provide structural angles welded to housing to accommodate load hangers for ceiling-hung fans.

C. Roof and Wall Ventilators

1. Ventilators shall be of sizes, arrangements and capacities as specified in the Schedules and as shown on the Contract Drawings.

2. Ventilators shall consist of housing, wheel, shaft, bearings, drive assembly, curb base, and accessories.

3. Wheels shall be backward inclined, non-overloading, centrifugal.

4. Provide solid, accurately turned, ground and polished shafts.

5. Provide grease-lubricated, precision anti-friction self-aligning ball bearings, to provide minimum L-10 life rating of 40,000 hours, in accordance with AFBMA Standard 9.

6. If "belt drive" ventilators are specified in the Schedules shown on the Contract Drawings, provide multiple matched V-belt drive with minimum 1.4 times rated motor horsepower. Provide adjustable pitch sheave on motor shaft, selected for midpoint at design conditions.

7. Provide removable 1/2-inch mesh aluminum bird screen at fan discharge.

8. Provide prefabricated curbs for roof ventilators, unless otherwise shown on the Contract Drawings.

9. Furnish wall ventilators with pre-punched plates for attachment to wall.

10. Furnish ventilators with gravity dampers and factory-wired disconnect switches, unless otherwise shown on the Contract Drawings.

D. Vibration Isolation

Provide vibration isolation in accordance with requirements specified in Division 15 Section entitled "VIBRATION ISOLATION AND CONTROL". Consult with the supplier of vibration isolation devices concerning the selection of the types required.

E. Motors

Provide motors in accordance with requirements specified in Division 15 Section entitled "MOTORS AND MOTOR CONTROLLERS". Select the motor characteristics, the motor mounting, and all accessories necessary to satisfy the requirements of the fan motor drive unit in all operating modes.

F. Explosion-Proof Construction

Where fans are specified on the Contract Drawings to be of explosion-proof construction, they shall be provided with non-sparking wheel and bearings, and shall have explosion-proof motor. Belt-driven fans shall be provided with antistatic belts. Explosion-proof construction fans shall be AMCA Design "A" with all parts in contact with the air stream of non-ferrous construction.

2.04 SHOP PAINTING

A. Fans and steel fabrication shall be factory coated with one coat of zinc chromate primer and one coat of machine enamel on both the exterior and interior surfaces.

B. For roof mounted fans, all steel components shall be coated with thermally fused epoxy.

2.05 SHOP TESTS

A. Balance fan wheels statically and dynamically prior to final operating tests with motor and drive in place.

B. Test, rate and certify fans in accordance with AMCA Standard 210 at an AMCA approved laboratory; fans shall bear AMCA seals. In lieu of shop performance tests, unless otherwise specified in the Schedules shown on the Contract Drawings, certified performance characteristic curves of prototype fans of similar units may be submitted for approval.

C. Sound rate fans in accordance with AMCA Standard 300; fans shall bear AMCA seals. Sound rating shall be based upon actual fan tests or upon prototype tests of similar units.

D. If specified in the Schedules shown on the Contract Drawings, the factory tests shall be witnessed by the Engineer. The Contractor shall notify the Engineer 14 days in advance of the scheduling of said factory tests.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install fans in accordance with manufacturer's installation procedures and recognized industry practices.

B. Coordinate all Work to ensure that the installation of fans is not in conflict with the work specified under other Sections.

C. For split construction fans, the installation shall be inspected by the manufacturer after field assembly who shall certify that the fans have been properly installed and are ready for proper operation.

D. Verify that electrical wiring installation is in accordance with manufacturer's submittal and in accordance with installation requirements of Division 16. Ensure that rotation is in direction indicated and intended for proper performance.

3.02 FIELD TESTS

A. Provide a qualified technical representative of the manufacturer to advise on field tests.

B. Start up, test, and adjust fans in presence of manufacturer's authorized representative.

END OF SECTION

SECTION 15860

CENTRIFUGAL FANS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15860A01 a. Details of fan construction components, dimensions of selected models, materials, gauges, finishes, weights, load distribution, required clearances and locations and sizes of field connections
b. Fan schedules.
c. Certified performance operating curves for pressure-volume relation for each fan.
d. Certified sound power levels at rated capacity at each octave band.
e. Catalog cuts of fans, specialties, accessories and other items specified in this Section.
f. Specialties and accessories.
g. Electrical wiring diagrams for power supply, interlock and controls.
h. Motor and electrical operating data.
i. Belt drive construction and rating.
j. Installation procedures.
k. Shop test results.

Construction and Installation Procedures

15860G01 Field test procedures.

Manuals, Warrantees/Guarantees

15860I01 Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawing and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s), bearings maintenance procedures, lubrication procedures and lubricant type.

Inspection Reports

15860O01 Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15890

METAL DUCTWORK AND ACCESSORIES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for metal ductwork (including flexible ducts) and accessories.

B. Ductwork accessories specified in this Section are:

1. Flexible Connectors.
2. Gravity (Backdraft) Dampers.
3. Manual volume Control Dampers.
4. Fire Dampers.
5. Ceiling (fire) Dampers.
6. Smoke Dampers.
7. Combination Smoke/Fire Dampers.
8. Ductwork Access Doors.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, as though the Authority were a private corporation, and the latest industry standards including, but not limited to those of the entities listed below.

New York City Building Code

New York City Board of Standards and Appeals (BSA)

New Jersey Uniform Construction Code

Air Movement and Control Association (AMCA)

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

American Society for Testing and Materials (ASTM)

American Welding Society (AWS)

National Fire Protection Association (NFPA)

Sheet Metal and Air-Conditioning Contractors National Association (SMACNA)

Steel Structures Painting Council (SSPC)

Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Ductwork accessories, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Ensure that entities performing the Work of this Section have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

Protect ductwork and accessories against damage during shipping, receiving, storing, and handling. Place guards over damageable parts. Mark each package for identification.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

Materials for ductwork and accessories shall be as specified below. All materials furnished shall comply with NFPA 90A.

Galvanized Steel Ductwork	ASTM A 527 with zinc coating conforming to ASTM A 525, coating designation G 90
Stainless Steel Ductwork (indicated on the Contract Drawings)	ASTM A 167, Type 304
Aluminum Ductwork (indicated on the Contract Drawings)	ASTM B 209, Alloy 3003, Temper to suit material thickness and tensile strength
Boiler Breeching	Black steel ASTM A 366 or A 569
Kitchen Exhaust Ductwork	Black steel, ASTM A 366 or A 569 for concealed area Stainless steel, ASTM A 167, Type 304 for exposed area
Hangers and Supports(including fasteners, anchors, rods, straps, trimand angles)	Matching materials of ductwork furnished
	Flexible Duct
Core	Spiral-wound steel spring with flameproof vinyl sheathing, complying with UL 181 or corrugated aluminum, complying with UL 181
Moisture Barrier	One-inch thick, continuous, flexible fiberglass sheath with vinyl vapor barrier jacket

	Acoustical Duct Liner
Liner	Insulation minimum density shall be 1.5 pounds per cubic foot. Insulation thickness, one inch.
Adhesives	ASTM C 916
Flexible Connectors	Double layer of 30-ounce per square yard, finished weight, fire retardant, glass cloth; double-coated with neoprene
	Gravity (Backdraft) Dampers
Frame	Aluminum, ASTM B 221, Alloy 6063, Temper 5
Blade	Aluminum, ASTM B 221, Alloy 6063, Temper 5
Tie Bars & Brackets	Aluminum
Blade Edge Seals	Extruded vinyl
Pivot Pins	Nonferrous
Bearings	Oil impregnated bronze or nylon
	Fire Dampers (To meet UL-555 requirements)
Frame	Galvanized steel
Closure Spring	Stainless steel
Blades	Galvanized steel
Perimeter Angle	Galvanized steel
	Ceiling (Fire) Dampers (To meet UL-555 requirements)
Frame	Galvanized steel
Blade	Galvanized steel with non-asbestos refractory insulation
	Smoke Dampers (To meet UL-555S requirements)
Frame	Galvanized steel
Blades	Galvanized steel
Bearings	Stainless steel sleeve, pressed into frame
Axles	Plated steel
Blade Seals	Silicone rubber
	Combination Smoke/Fire Dampers (To meet UL-555 and UL- 555S requirements)
Frame	Galvanized steel
Blades	Galvanized steel
Bearings	Stainless steel sleeve, pressed into frame
Axles	plated steel
Blade Seals	Silicone rubber
	Access Doors
Frame	Same material as ductwork
Gasket	Neoprene rubber
Double Wall Casing Core Insulation	Fiberglass or rock wool, 2.5 lb. per cubic foot minimum density

2.02 FABRICATION

A. Ductwork, Casings and Plenums

1. Unless otherwise shown on the Contract Drawings or specified herein, gauges, reinforcement, and fabrication of all ductwork, casings and plenums, including hangers and supports, shall be in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible".

2. Ductwork sizes shall conform to the dimensions shown on the Contract Drawings.

3. All ductwork sizes shown on the Contract Drawings are clear inside dimensions. Where internal acoustical lining is required, sheet metal duct sizes shall be correspondingly increased to accommodate the liner thickness so that net cross-sectional flow areas will not be reduced.

4. Furnish all ductwork, elbows, vanes, transition pieces, branch takeoffs, and manual volume dampers as shown on the Contract Drawings.

5. Unless otherwise indicated on the Contract Drawings, limit angular tapers to 30 degrees for diverging concentric transition and 60 degrees for converging concentric transition. Unless otherwise shown on the Contract Drawings, limit eccentricity angles for eccentric transitions and offsets to those recommended by SMACNA "HVAC Duct Construction - Metal and Flexible".

6. Radius elbows shall have a center line radius equal to 1-1/2 times duct width. Provide turning vanes in elbows whose centerline radius is less than 150 percent of duct width or where indicated on the Contract Drawings. Fabricate turning vanes of single thickness of similar material as duct. Square elbows shall have double thickness turning vanes.

7. Do not use friction clamps for hangers and supports. Provide all supplementary steel required for installation of ductwork hangers and supports. All structural welding for hangers and supports shall be in accordance with AWS D 1.1.

8. Flexible duct shall be of length not exceeding limitations in NFPA 90A and local codes, and shall have no intermediate seams. Provide moisture barrier where the flexible duct is located in unconditioned space other than within return air plenums.

9. Install acoustical duct liner for the distance shown on the Contract Drawings. Noise reduction coefficient for one-inch thick lining shall be not less than 0.70 based on ASTM C 423 test method. Installing two layers of liner to meet a minimum liner thickness will not be acceptable. Liner shall be fastened with adhesive and welded pin type mechanical fasteners.

10. Provide sleeves and flanges at ductwork penetrations of inside walls, except where fire dampers are installed. Extend ductwork insulation and vapor barrier through the ductwork sleeve. Sleeves shall be two inches larger than the ductwork plus its insulation. Provide counterflashing for all penetrations through exterior walls or roof.

11. Provide airtight penetrations where shown on the Contract Drawings.

12. Provide double wall casing, with two-inch thick insulated core, where shown on the Contract Drawings.

13. Air inlets and outlets shall be connected to the ductwork with collars so that neither the air inlet/outlet nor its damper will extend into the duct.

14. Instrument Test Ports

Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments, and provided in length to suit duct insulation thickness.

B. Kitchen Exhaust Ductwork

Provide kitchen exhaust ductwork in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible", and NFPA 96. All welding of kitchen exhaust ductwork shall be in accordance with AWS D 9.1.

C. Boiler Breeching

1. Unless otherwise shown on the Contract Drawings, gauges, reinforcements, and fabrication of boiler breeching shall be in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible".

2. All breeching shall have continuous weld joints and seams. All welding shall be in accordance with AWS D 9.1.

3. Maintain the required minimum distance from combustible materials as required by applicable codes.

4. Blind flanged cleanout shall be installed as shown on the Contract Drawings. Doors shall be double panel, insulated with two-inch calcium silicate and shall be gasketed.

5. Provide test holes and access doors in breeching as required for testing and cleaning. Test holes shall be sealed with plugs.

2.03 ACCESSORIES

A. Flexible Connectors

1. Provide flexible connectors at inlet and discharge of all fans and locations shown on the Contract Drawings.

2. Flexible connectors shall be in accordance with NFPA 90A or 96, as applicable.

B. Backdraft Dampers

1. Backdraft dampers shall be parallel blades, counterbalanced, heavy-duty type capable of withstanding maximum spot velocities of up to 3500 fpm.

2. Counterbalance setting shall be adjustable so that the damper can be operated in the range of 0.25 to 0.75-inch water gauge differential pressure, unless otherwise shown on the Contract Drawings.

C. Manual Volume Control Dampers

1. Unless otherwise indicated on the Contract Drawings, volume dampers shall be provided with the general configuration, materials and application limits indicated in SMACNA "HVAC Duct Construction Standards - Metal and Flexible".

2. Provide volume dampers in each branch takeoff where shown on the Contract Drawings, and additionally where required for balancing the air flow in the systems.

3. Dampers installed in ducts up to 12 inches high shall be single blade type.

4. Dampers installed in ducts over 12 inches high shall be opposed multiple-blade type.

5. Dampers shall be stable under operating conditions. Stiffen damper blades by forming or by other method if required for the duty.

6. Provide single blade dampers with a locking device to hold dampers in a fixed position without vibration, pulsation, rattling or similar reaction to system pressure variations.

7. Close damper component penetration of duct as is consistent with the sealing classification applicable for the pressure class of the duct. End bearings or other seals shall be provided on 3-inch w.g. static pressure class.

8. The installation of damper in lined duct shall not damage liner or cause liner erosion.

9. Provide damper quadrants. They shall be fitted with sheet metal stools where installed in insulated ductworks, so that device is flush with outer insulation surface.

D. Fire Dampers

1. Provide fire dampers in accordance with UL 555.

2. Fire dampers shall bear a UL label and shall be approved by New York City Board of Standards and Appeals for projects located in New York City.

3. Fire resistance ratings of fire dampers shall comply with NFPA 90A and the New York City Building Code Reference Standard RS 13 for projects located in New York City.

4. Fire dampers shall be curtain-type with damper curtain located outside of air stream unless otherwise indicated on the Contract Drawings.

5. Fire dampers placed in vertical position shall be gravity-operated. Fire dampers placed in horizontal position shall be provided with all necessary springs and latches.

6. Provide fire dampers with fusible links rated at 165 degrees F, unless otherwise shown on the Contract Drawings.

7. Expansion clearance requirements between the sleeve and protected openings shall be as shown on approved manufacturer's drawings.

8. Provide access doors in the ductwork to permit inspecting, testing and resetting the damper.

9. Install fire dampers in duct extension sleeves with perimeter (mounting) angles and breakaway joints in accordance with NFPA 90A, SMACNA "Fire Damper and Heat Stop Guide" and the requirements below.

10. Extension sleeves shall not extend more than six inches beyond the fire wall or partition, or floor on each side where it connects to ductwork.

11. Secure sleeves by perimeter angles on four sides of the sleeve on both sides of opening.

12. Breakaway joints shall be Engineer-approved S-slip type.

E. Ceiling (Fire) Dampers

1. Construct and test ceiling dampers in accordance with UL 555.

2. Ceiling dampers shall bear a UL label and shall be approved by New York City Board of Standards and Appeals for projects located within New York City.

3. Fire resistance ratings of ceiling dampers shall comply with NFPA 90A and UL 555, and with New York City Building Code, RS13 for projects located within New York City.

4. Provide ceiling dampers with fusible links rated at 165 degrees F, unless otherwise shown on the Contract Drawings.

5. Ceiling dampers shall be suitable for installation inside ductwork and surface mounting of diffusers or grilles. Hanger straps for mounting ceiling dampers, if utilized, shall be of minimum gauge and size, consistent with UL.

6. Provide volume adjustment features in the fusible link to permit adjustment of damper blades to balance airflow through the damper.

F. Smoke/Fire and Smoke Dampers and Actuators

1. Dampers and actuators designated on the Contract Drawings as "S/F" shall comply with the following:

   a. Dampers shall be electrically operated combination fire and smoke dampers. They shall conform to UL Standards 555 as fire dampers and 555S as leakage rated smoke dampers for use in a smoke purge system; and when closed shall have the same fire resistance rating as the fire rated partition in which they are installed, or as required by code. Unless indicated otherwise on the Contract Drawings, leakage shall conform to Class II with maximum leakage of 10 CFM/Square Feet at 1-inch w.g. differential pressure.

   b. Dampers shall be controlled from smoke detector(s) installed remotely in ducts as indicated on the Contract Drawings and shall be provided with heat sensors that shall close and lock the respective dampers in the event of a fire.

   c. Each damper shall be provided with position indicator switches to enable remote status monitoring of its open/closed position.

   d. S/F damper actuators and heat sensors shall remain operational regardless of the operational status of the associated HVAC system.

2. Dampers and actuators designated on the Contract Drawings as "S/D" are smoke dampers. They shall comply in all respects to S/F damper description above, including position indicating switches, except they shall not be provided with a heat sensor or fusible link assemblies.

3. S/F and smoke dampers shall comply with NFPA 90A, in addition to Local Code requirements.

4. Each S/F and smoke damper shall bear UL label.

5. S/F and smoke dampers shall be suitable for the mounting position indicated on the Contract Drawings.

G. Ductwork Access Doors

1. Install hinged access doors in ductwork where shown on the Contract Drawings.

2. Where hinged access doors cannot be provided with a clear 180-degree swing, removable access doors shall be used.

3. Provide gasketed, insulated double-panel access doors in insulated ducts. For kitchen exhaust ductwork, the insulation shall be two-inch thick calcium silicate. Access doors in uninsulated ducts may be of single panel construction.

4. Install access doors in ductwork with separate frames.

H. Accessories Hardware

1. Splitter Damper Accessories

Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

2. Flexible Duct Clamp

Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action.

3. Adhesives

High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.04 SHOP PAINTING

A. Prepare exterior surfaces of black steel ductwork, except edges prepared for field welding, in accordance with SSPC-SP 6. Apply one shop coat of primer.

B. Do not paint finished surfaces, polished areas, galvanized steel, stainless steel, and aluminum materials.

2.05 SHOP TESTS

For gravity dampers, furnish a certificate of compliance with AMCA Standard 500.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install ductwork and accessories in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" and ductwork accessory manufacturers' installation recommendations.

B. Contract Drawings show general intent for routing the ductwork. all indicated locations are approximate, and in that respect, the duct routing as shown on the Contract Drawings shall be deemed schematic. It shall be Contractor's responsibility to coordinate with Work of other Sections to ensure that no conflict exists in installation of ductwork and no ceilings, equipment or other materials are supported from ductwork or the ductwork hanger and support system.

C. Coordinate as necessary, to ensure that access doors or indicator buttons have been provided in hung ceilings for proper operation and maintenance of the installation.

D. Provide adequate space around ducts to assure proper support and to allow the installation of insulation if specified.

E. Route ductwork to minimize unnecessary directional changes and abrupt transitions. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

F. Where duct size does not conform to nearest standard accessory size (e.g. volume control damper), transform duct to match the next larger accessory size.

G. Maintain the interior of ductwork free of dirt and debris. Close off temporarily all openings in the ducts during construction of the building. Clean thoroughly all ducts before installing any filters or operating fans. Never operate fans unless filters are installed. After tests, but before acceptance, wash all cleanable filters and replace all renewable media.

H. Provide for thermal expansion of kitchen hood exhaust ductwork through 2,000°F temperature range. Install this ductwork without dips or traps that may collect residues. Provide an access opening at each change in direction, and at 50-foot intervals, and locate on side of duct 1-1/2 inches minimum from bottom of duct.

I. Support horizontal ducts per SMACNA and within 2 feet of each elbow, and within 4 feet of each branch intersection.

J. Support vertical ducts per SMACNA and at maximum intervals of 16 feet, and at each floor.

K. Connect equipment to ductwork with flexible connectors.

3.02 FIELD TESTS

A. Perform a leakage test of the ductwork in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".

B. The Contract Drawings indicate the pressure classes of ductwork; they also indicate which pressure classes are to be leak tested. Contractor shall, at the beginning of the work, construct, erect and leak test a sample, to be selected at random by the Engineer, of the duct construction to be used at each pressure class scheduled for testing.

C. The leakage amount shall not exceed the following allowable amount for the pressure class.

Duct Construction Class	Leakage Class
10" w.g.	3
6" w.g.	6
4" w.g.	6
3" w.g.	12

Note: See Section 4 of the SMACNA leakage test manual for normal classification.

D. Leakage test procedures shall follow the outlines and classifications in the SMACNA HVAC Duct Leakage Test manual.

E. If specimen fails to meet allotted leakage level, the Contractor shall modify it to bring it into compliance, and shall retest it. Modifying and re-testing shall be repeated until acceptable leakage is demonstrated.

F. Tests and necessary repair shall be completed prior to concealment of ducts.

END OF SECTION

SECTION 15890

METAL DUCTWORK AND ACCESSORIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15890A01 Shop and coordination drawings shall be double-line and shall be at a minimum of 3/8"-1'-0" scale.

a. Ductwork layout and installation drawings including, at a minimum, the following:

1. Plans, elevations and sections.
2. Hangers, support locations and details. Indicate methods of attachment to building structure.
3. Duct elevations and dimensions from main duct runs to a reference point.
4. Penetrations through fire-rated and other partitions.
5. Locations for duct accessories, including dampers, turning vanes and access doors.

b. Ductwork coordination drawings showing plan views, sections, and ductwork elevations, drawn to scale, on which all items are shown and coordinated with Work of other Sections.

Product Data

15890D01 Ductwork construction standards including, at a minimum, the following:

a. Longitudinal and transverse joining methods and details.
b. Standard details indicating all aspects of assembly, fittings and accessories.
c. Reinforcement and spacing.

15890D02 a. Product performance data including, at a minimum, materials, components, dimensions of individual components, finishes, weights, loadings, required clearances, methods of field assembly, profiles and location and size of each field connection for all items furnished under this Contract, including the following at a minimum:

1. Acoustical duct liners.
2. Flexible duct.
3. Ductwork access doors, including locations and sizes.
4. Duct turning vanes.
5. Accessories hardware.

b. Catalog cuts for all types of furnished accessories.
c. Shop test results.

15890D03 Product performance data including but not limited to materials, components, dimensions of individual components, finishes, weights, loadings, required clearances, methods of field assembly, profiles, and location and size of each field connection for the following items:

1. Dampers (manual volume, gravity backdraft, fire, ceiling fire, smoke, combination smoke/fire).

Manufacturer Test Reports

15890F01 Certified test data on airflow performance including pressure losses, self-noise power levels and dynamic insertion losses, as applicable for the various components and accessories.

Construction and Installation Procedures

15890G01 Field test procedures.

Inspection Reports

15890O01 Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15910

CONTROL SYSTEM FOR MECHANICAL EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS) utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Authority.

C. The Authority shall be the named license holder of all software associated with any and all incremental work on the project(s).

D. The new BAS control system must be capable of interfacing with the existing SIB administration BAS. A Honeywell WEB-600 controller shall be utilized in the existing administration building to connect the existing BAS to the new work.

1.02 SYSTEM DESCRIPTION

A. The entire Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via BACnet™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturers. BACnet™ products must be approved in writing by the Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

B. The Building Automation System (BAS) consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.

C. The Building Automation System (BAS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Authority's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to BACnet™ (IBC) controllers and other open protocol systems/devices provided.

D. The Building Automation System (BAS) as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara AX Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara AX Framework™ platform are unacceptable.

E. The Building Automation System (BAS) shall monitor and control equipment as called for by the "Sequence of Operation" and points list.

F. The Building Automation System (BAS) shall provide full graphic software capable of complete system operation for up to 34 simultaneous Thin-Client workstations.

G. The Building Automation System (BAS) shall provide full graphic operator interface to include the following graphics as a minimum:

1. Home page to include a minimum of six critical points, i.e. Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW etc.
2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
3. Detail graphics for each mechanical system to include; Computer room air conditioning units, Exhaust Fans, Heat Pumps, Fan coils, Chillers and associated controls, Boilers, water meters, gas meters, electric meters, smoke detectors, smoke purge system, fire/smoke dampers, etc.
4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

H. The Building Automation System (BAS) shall provide the following data links to electronically formatted information for operator access and use.

1. Project control as-built documentation; to include all BAS drawings and diagrams converted to Adobe Acrobat .pdf filers.
2. BAS Bill of Material for each system.
3. Technical literature specification data sheets for all components listed in the BAS Bill of Material.
4. Sequence of operation for all BAS provided systems.

I. The BAS shall provide automated alarming software capable of sending messages to user email addresses via the Authority's e-mail service. The email alarm paging system shall be able to segregate users, time schedules, and equipment, and be capable of being programmed by the Authority.

J. It is preferable that any dedicated configuration tool required for controller configuration have the capability to be launched from within the applicable Network Management Software. If the configuration tool(s) can not be launched from the Network Management Software, any software required for controller configuration shall be included as a leave-behind tool with enough license capability to support the installation.

K. The contractor shall provide the appropriate quantity of legal copies of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be generally available in the market. No closed and/or unavailable tools will be permitted. Contractor shall convey all software tools and their legal licenses at project close out.

1.03 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

DDC	Direct Digital Controls
BAS	Building Automation System
GUI	Graphical User Interface
IBC	Interoperable BACnet Controller
IDC	Interoperable Digital Controller
LAN	Local Area Network
NAC	Network Area Controller
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
PMI	Power Measurement Interface
POT	Portable Operator's Terminal
WAN	Wide Area Network
WBI	Web Browser Interface

1.04 SCOPE OF WORK

B. The Contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and controller network wiring.

C. The Contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, network management and connection of the NAC to the local or wide area network.

1.05 RELATED WORK SPECIFIED ELSEWHERE

D. Division 16, Electrical:

1. Providing motor starters and disconnect switches for related motor driven equipment.
2. Power/low voltage wiring and conduit.

3. Provision, installation and wiring of duct smoke detectors.

1.06 AGENCY AND CODE APPROVALS

E. All products of the BAS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems
2. UL-864; Smoke Control
3. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
4. CE
5. FCC, Part 15, Subpart J, Class A Computing Devices

1.07 SOFTWARE LICENSE AGREEMENT

F. The Authority shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to The Authority as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

G. The Authority shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Authority shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BAS, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Authority.

H. The Authority, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara AX Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and all connected routers and devices.

1.08 DELIVERY, STORAGE AND HANDLING

I. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.09 JOB CONDITIONS

J. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2. MATERIALS

2.01 GENERAL

A. The Building Automation System (BAS) and Facility Management Control System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide the product by the manufacturer specified.

1. Honeywell
2. Johnson Controls
3. Siemens
4. Or Approved Equal

2.03 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet™, LonWorks™ technology, MODBUS ™, OPC, and other open and proprietary communication protocols into one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for local network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.04 NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabit/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3

2. Cable; 100-Base-T, UTP-8-wire, category 5

3. Minimum throughput; 100 Mbps.

2.05 NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet.

2.06 NETWORK AREA CONTROLLER (NAC)

A. The Contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of required.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions

2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data and BACnet controller data
7. Network Management functions for all LonWorks and/or BACnet based devices

C. The Network Area Controller shall provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps
2. One RS-232 port
3. One LonWorks Interface Port – 78KB FTT-10A if Lon controllers are used and/or One RS-485 port if BACnet controllers are used.
4. Battery Backup
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. The NAC must be capable of operation over a temperature range of 32 to 122°F
7. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

F. Event Alarm Notification and actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
   a. In alarm
   b. Return to normal
   c. Fault condition

4. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and/or classes of alarms, i.e.: security, HVAC, Fire, etc.

5. Provide timed (schedule) routing of alarms by class, object, group, or node.

6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Controller and network failures shall be treated as alarms and annunciated.

H. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text

2. Email of the complete alarm message to multiple recipients via the Authority's e-mail service. Provide the ability to route and email alarms based on:

   a. Day of week

   b. Time of day

   c. Recipient

3. Pagers via paging services that initiate a page on receipt of email message via the Authority's e-mail service

4. Graphic with flashing alarm object(s)

5. Printed message, routed directly to a dedicated alarm printer

I. The following shall be recorded by the NAC for each alarm (at a minimum):

1. Time and date

2. Location (building, floor, zone, office number, etc.)

3. Equipment (air handler #, access way, etc.)

4. Acknowledge time, date, and user who issued acknowledgement.

5. Number of occurrences since last acknowledgement.

J. Alarm actions may be initiated by user defined programmable objects created for that purpose.

K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a "query" feature to allow review of specific alarms by user defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.07 Data Collection and Storage

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:

1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values
5. PDF

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

1. Archive on time of day
2. Archive on user-defined number of data stores in the log (buffer size)
3. Archive when log has reached it's user-defined capacity of data stores
4. Provide ability to clear logs once archived

2.08 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID

3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

1.2 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.09 ADVANCED UNITARY CONTROLLER

A. The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation" as outlined in Section 4.

B. Minimum Requirements:

1. The controller shall be capable of either integrating with other devices or stand-alone operation.

2. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.

3. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.

   a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.

   b. Accuracy: ±1 minute per month at 77° F (25° C).

   c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).

4. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.

5. The controller shall have an internal DC power supply to power external sensors.

   a. Power Output: 20 VDC ±10% at 75 mA.

6. The controller shall have a visual indication (LED) of the status of the devise:

   a. Controller operating normally.

   b. Controller in process of download.

c. Controller in manual mode under control of software tool.

d. Controller lost its configuration.

e. No power to controller, low voltage, or controller damage.

f. Processor and/or controller are not operating.

7. The minimum controller Environmental ratings

a. Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).

b. Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).

c. Relative Humidity: 5% to 95% non-condensing.

8. The controller shall have the additional approval requirements, listings, and approvals:

a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.

b. CSA (LR95329-3) Listed

c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.

d. Meets Canadian standard C108.8 (radiated emissions).

e. Conforms to the following requirements per European Consortium standards:
EN 61000-6-1; 2001 (EU Immunity)
EN 61000-6-3; 2001 (EU Emissions)

9. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

10. The controller shall have sufficient on-board inputs and outputs to support the application.

a. Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.

b. Triac outputs shall be capable of switching 30 Volts at 500 mA.

c. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.

d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

11. The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.

a. The controller shall support 62 Network Variables with a byte count of 31 per variable.

b. The controller shall support 1,922 separate data values.

12. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.

13. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.

a. Discharge air control and low limit

b. Pressure-dependent dual duct without flow mixing.

c. Variable air volume with return flow tracking.

d. Economizer with differential enthalpy.

e. Minimum air flow coordinated with CO2.

f. Unit ventilator cycle (1,2,3) 2-pipe.

g. Unit ventilator cycle (1,2,3) 2-pipe with face/bypass.

A. GRAPHICAL USER INTERFACE SOFTWARE:Operating System The Workstation with GUI shall run on Microsoft Windows XP Professional. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimal knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

B. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

14. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background the GUI shall support the use of scanned pictures.

15. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

16. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

17. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

    a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

    b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.

18. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.

19. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No text entry shall be required.

C. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

a. Create, delete, or modify control strategies.

b. Add or delete objects to the system.

c. Tune control loops through the adjustment of control loop parameters.

d. Enable or disable control strategies.

e. Generate hard copy records or control strategies on a printer.

f. Select points to be alarmable and define the alarm state.

g. Select points to be trended over a period of time and initiate the recording of values automatically.

D. On-Line Help. Provide a context sensitive on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for the currently displayed screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

E. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a specified time. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

F. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

G. Alarm Console

1. The system shall be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console may be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.10 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in

terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.

6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned; the user shall be able to perform the following:

   a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

      1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

      2. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

   b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.

   c. View logs and charts

   d. View and acknowledge alarms

   e. Setup and execute SQL queries on log and archive information

7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to set a specific home page for each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.11 SERVER FUNCTIONS AND HARDWARE

A. A central server shall be provided. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote.

B. Local connections shall be via an Ethernet LAN.

C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

D. The server shall provide the following functions, at a minimum:

1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).

2. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.

3. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

4. The server shall be capable of providing demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

5. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.

6. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

7. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:

8. Routing of alarms to display, printer, email and pagers

9. View and acknowledge alarms

10. Query alarm logs based on user-defined parameters

11. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

12. Viewing and printing log data

13. Exporting log data to other software applications

14. Query log data based on user-defined parameters

15. Server Hardware Requirements: Server shall be provided by the Port Authority.

2.12 SYSTEM CONFIGURATION TOOL

A. The Workstation Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.13 LIBRARY

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the BACnet specification.

E. The library shall include applications or objects for the following functions, at a minimum:

1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.

2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a

message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.

3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of

equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.

2. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.

3. For BACnet devices, provide the following objects at a minimum:

   a. Analog In

   b. Analog Out

   c. Analog Value

   d. Binary

   e. Binary In

   f. Binary Out

   g. Binary Value

   h. Multi-State In

   i. Multi-State Out

j. Multi-State Value

k. Schedule Export

l. Calendar Export

m. Trend Export

n. Device

4. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

5. For BACnet devices, provide the following support at a minimum

a. Segmentation

b. Segmented Request

c. Segmented Response

d. Application Services

e. Read Property

f. Read Property Multiple

g. Write Property

h. Who-has

i. I-have

j. Who-is

k. I-am

l. Media-Types

m. Ethernet

n. BACnet IP Annex J

o. MSTP

p. BACnet Broadcast Management Device (BBMD) function

q. Routing

2.14 DDE DEVICE INTEGRATION

A. The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BAS. Objects provided shall include at a minimum:

1. DDE Generic AI Object

2. DDE Generic AO Object

3. DDE Generic BO Object

4. DDE Generic BI Object

C. The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

a. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:

1. Read/Write Modbus AI Registers

2. Read/Write Modbus AO Registers

3. Read/Write Modbus BI Registers

4. Read/Write Modbus BO Registers

D. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

E. The BAS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

2.15 OPC SYSTEM INTEGRATION

A. The Network Area Controller shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

a. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BAS. Objects provided shall include at a minimum:

1. Read/Write OPC AI Object

2. Read/Write OPC AO Object

3. Read/Write OPC BI Object

4. Read/Write OPC BO Object

5. Read/Write OPC Date/Time Input Object

6. Read/Write OPC Date/Time Output Object

7. Read/Write OPC String Input Object

8. Read/Write OPC String Output Object

B. All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller.

C. The BAS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

2.16 OTHER CONTROL SYSTEM HARDWARE

A. Space Temperature Wall Module: Temperature sensing modules mounted on the wall in occupied spaces. Setpoint, indication, and override switches must be provided as specified.

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the manufacturers specified.
   a. AME Inc.
   b. ACI
   c. Honeywell
   d. Or approved equal

2. Wall module shall have a thermistor temperature sensor with operating range of 45 to 120 deg. F. under a locking cover/enclosure designed for mounting on a standard electrical switch box.

3. Space temperature sensors shall be accurate to plus or minus 0.5 deg. F at 77 deg. F.

4. Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments.

5. Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.

6. Where specified, wall module shall have an LCD display with 2 level user access. Level one access shall be available for typical occupant adjustments, and level two access for system configuration. Level two access shall be accessible only via password or multi-key code input. Room temperature, room temperature setpoint, VAV balancing parameters and settings, occupancy override, and other control parameters for a total of at least 35 items shall be available via the keypad/display. Wall module screens shall be configurable for typical tenant and control contractor views.

B. Duct Mount, Pipe Mount, and Outside Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. AME Inc.
   b. ACI
   c. Honeywell
   d. Or approved equal

2. Outside air sensors shall include an integral sun shield.

3. Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.

4. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.

5. Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).

6. Pipe mount sensors shall have copper, or stainless steel separable wells.

C. Current Switches: Solid state, split core, current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. ACI
   b. Honeywell
   c. RIB, Inc.
   d. Veris Industries
   e. Or approved equal
2. Sensing range 0.5 – 250 Amps.
3. Output 0.3 A @ 200 VAC/VDC / 0.15 A @ 300 VAC/VDC
4. Operating frequency 40 Hz -1 kHz.
5. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
6. Approvals CE, UL.

D. Current Sensors: Solid state, split core linear current sensors shall be provided where specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. ACI
   b. Honeywell
   c. RIB, Inc.
   d. Veris Industries
   e. Or approved equal
2. Linear output of 0-5 VDC, 0-10 VDC, or 4-20 mA.
3. Scale sensors so that average operating current is between 20-80% full scale.
4. Accuracy plus or minus 1.0% (5-100% full scale)
5. Operating frequency 50-600 Hz.
6. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
7. Approvals CE, UL.

E. Water Flow Meters: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Fluid Components International
   b. Hersey Meters
   c. Onicon Meters

d. Or approved equal

2. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
3. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
4. Accuracy shall be ± 2% of actual reading from 0.4 to 20 feet per second flow velocities.

F. Low Temperature Limit Switches. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Or approved equal
2. Low Limit Setpoint shall be adjustable between 20 and 60 deg. F. (-5 and 15 deg. C.)
3. Switch enclosure shall be dustproof and moisture-proof.
4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10.2 FLA at 120 VAC, and 6.5 FLA at 240 VAC.
5. Ambient Temperature range -20 to 125 deg. F. (-11 to 52 deg. C.)
6. Operating Temperature Range 20 to 60 deg. F. (-5 to 15 deg. C.)

G. High Temperature Limit Switches. Safety high limit (fire stats) shall be manual reset type.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Johnson Controls
   c. Siemens Building Technologies
   d. TAC
   e. Or approved equal
2. High Limit Setpoint shall be adjustable between 100 and 240 deg. F. (38 and 116 deg. C.)
3. Switch enclosure shall be dustproof and moisture-proof.
4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10 FLA at 120 VAC, and 5 FLA at 240 VAC.
5. Ambient Temperature range -20 to 190 deg. F. (-28 to 88 deg. C.) at case, and 350 deg. F (177 deg. C.) at the sensor.
6. Operating Temperature Range 100 to 240 deg. F. (38 to 116 deg. C.)

H. CO2, CO, NOx Sensors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. TelAire
   c. Vaisala
   d. Or approved equal

2. Carbon Dioxide sensors shall be 0-10 Vdc, 2-10 Vdc, or 4-20 mA linear analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct or wall mounting.

3. Sensor shall incorporate internal diagnostics for power, sensor, analog output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0-2000 PPM with +/- 75 PPM accuracy at full scale.

4. Where specified, sensor shall have an LCD display that displays the sensor reading and status.

I. Differential Pressure Sensors

1. Manufacturers:
   a. ACI
   b. Honeywell
   c. RIB, Inc.
   d. Veris Industries
   e. Or approved equal

2. Sensor shall have four field selectable ranges: 0.1, 0.24, 0.5, 1.0 in w.c. for low pressure models, and 1.0, 2.5, 5, 10 for high pressure models.

3. Sensor shall provide zero calibration via pushbutton or digital input.

4. Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA

5. Where specified, sensor shall have and LCD display that displays measured value.

6. Sensor overpressure rating shall be 3 PSID proof, and 5 PSID burst.

7. Sensor accuracy shall be plus or minus 1% FS selected range.

J. Humidity Sensors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Johnson Controls
   c. Siemens Building Technologies
   d. TAC
   e. Or approved equal
2. Humidity transducer shall be accurate to +/- ***(2%, 3%, 5% choose desired accuracy)*** between 20-95% RH NIST traceable calibration.
3. Sensors shall have a field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
4. Sensors shall provide field calibration option using non-interacting zero and span potentiometers, and/or toggle switches that increment or decrement the RH value in steps of 0.5% RH.
5. Accuracy of the sensor shall not be adversely affected by condensation.

K. Enthalpy Sensors.

Provide duct mounted sensor including solid state temperature and humidity sensors with electronics which shall output a 4-20 ma signal input to the controller upon a varying

enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Siemens Building Technologies
   c. Or approved equal

L. Annular Pitot Tube Flow Meter. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Air Monitor Corporation
   b. Ultratech
   c. Wetmaster Co., Ltd.
   d. Johnson Controls
   e. Or approved equal

2. Sensor shall have an accuracy of ± .25% of full flow and a repeatability of ± .05% of measured value.

3. Transmitter shall be electronic and shall produce a linear output of 0-10 Vdc, 0-5 Vdc, or 4 to 20 mA dc corresponding to the required flow span.

4. The transmitter shall include non-interacting zero and span adjustments.

M. Standard Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Greenheck
   b. Honeywell
   c. Johnson Controls
   d. Ruskin
   e. Or approved equal

2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.

3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.

4. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.

5. Dampers shall be suitable for temperature ranges of -40 to 180F.

6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized.

8. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.

N. Low Leakage Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Greenheck
   b. Honeywell
   c. Johnson Controls
   d. Ruskin
   e. Or approved equal

2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.

3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.

4. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.

5. Dampers shall be suitable for temperature ranges of -40 to 180F.

6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.

8. Side seals shall be stainless steel of the tight-seal spring type.

9. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.

10. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.

11. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.

12. Testing and ratings shall be in accordance with AMCA Standard 500.

13. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

O. Round Motorized Dampers. Round dampers shall be provided where specified and shall be factory mounted in a section of round duct a minimum of 12 inches long, but no less than one inch longer than the duct diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Greenheck
   b. Honeywell
   c. Johnson Controls
   d. Ruskin
   e. Or approved equal

2. Duct shall be sleeve type spiral duct crimped on the downstream end, 24 gage galvanized minimum except duct over 12 inches in diameter shall be 22 gage.

3. Duct shall have an integral galvanized steel actuator mounting plate and a ½ inch zinc-coated steel blade shaft extending a minimum of 2 inches beyond the actuator mounting plate.

4. Shaft bearings shall be flanged bronze oilite pressed into the frame.

5. The blade shall be a minimum 16 gage galvanized steel, and damper frame shall be provided with closed-cell neoprene seals with silicone rubber bead. Damper shall be designed for a 2500 ft/min approach velocity and a 4 inch minimum static pressure.

6. Damper shall be suitable for operation from 32 to 130F temperatures.

7. Damper and actuator combination shall be designed for leakage rates less than 13 cfm per square foot at one inch w.c. differential and 25 cfm at four inches w.c. Actuator shall have an external declutch lever to allow manual blade positioning during equipment and power malfunctions.

P. **Actuators, General.** All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.

Q. Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators. Actuators shall be 35 or 70 lb-in. with strokes adjustable for 45, 60, or 90 degree rotation applications and designed for operation between 20 and 125 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

a. Honeywell
b. Johnson Controls
c. Siemens Building Technologies
d. TAC
e. Or approved equal

2. Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.

3. Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.

4. Analog control actuators shall have a cover mounted direct/reverse acting switch.

5. Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.

6. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

7. Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.

8. Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.

9. Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.

R. Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in., 88 lb-in., or 175 lb-in. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Johnson Controls
   c. Siemens Building Technologies
   d. TAC
   e. Or approved equal

2. Each torque rating group shall have optionally selected control types, floating control, 2-position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.

3. Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.

4. Actuators shall be direct connected (no linkages), and shall have integral position indication.

5. Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.

6. Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.

7. Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.

8. Upon power restoration after gear lock, normal operation shall automatically recur.

S. Fast Acting Two Position Fire & Smoke Actuators. Fire/smoke damper actuators shall be direct connected (no linkages) two-position spring return types with stroke for 90 degree nominal rotation applications and designed for 60,000 full stroke cycles and normal operation between 0 and 130 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   a. Honeywell
   b. Siemens Building Technologies
   c. Or approved equal

2. Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.

3. Actuator timing shall be 25 seconds maximum in powered instances and shall spring-return in 15 seconds.

4. Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.

5. The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.

6. Actuator shall require no special cycling during long-term holding, and shall "hold" with no audible noise at a power consumption of approximately half of the driving power.

7. Actuators shall be 24 volt or 120 volt with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return.

T. Temperature Control Panels: Furnish and install NEMA 4X temperature control panels with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

PART 3. EXECUTION

3.01 INSTALLATION

A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

B. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

C. Drawings of the BAS and BAS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

E. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

3.02 WIRING

A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the this contractor.

B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All BAS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where BAS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.03 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Authority, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Authority

3.04 WARRANTY ACCESS

A. The Authority shall grant to this contractor, reasonable access to the BAS and BAS during the warranty period.

B. The Authority shall allow the contractor to access the BAS and BAS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.05 ACCEPTANCE TESTING

A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Authority's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Authority's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Authority's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.06 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the BAS and BAS hardware and software has been established this contractor shall provide on-site operator instruction to the Authority's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. This contractor shall provide 40 hours of instruction to the Authority's designated personnel on the operation of the BAS and BAS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

C. The training shall be in three sessions as follows:

1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the Authoritys' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

3. Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the Authority during the one year warranty period. These sessions shall cover topics as requested by the Authority such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

END OF SECTION

SECTION 15910

CONTROL SYSTEM FOR MECHANICAL EQUIPMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Eight copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.

   1. Damper Schedule: Damper and actuator sizing shall be performed, and a schedule created by the manufacturer. The schedule shall include a separate line for each damper and a column for each of the damper attributes:. Damper. Identification Tag, Location, Damper Type, Damper Size, Duct Size, Arrangement, Blade Type, Velocity, Pressure Drop, Fail Position, Actuator Identification Tag, Actuator Type, and Mounting.

B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media, and protocol. The Contractor is responsible for integrating the diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN) and/or Local Area Network (LAN) utilized by the BAS.

   1. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system expansion with minimal infrastructure modifications.

C. Submittal shall also include a complete point list of all points to be connected to the BAS and BAS. The Contractor shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the BAS.

D. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this

stage with the only remaining changes to be based on review comments from the A/E design team and/or Authority.

E. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. The Contractor shall provide as-builts for their portions of work. The Contractor shall be responsible for as-builts pertaining to overall BAS and BAS architecture and network diagrams. All as-built drawings shall also be installed into the BAS server in a dedicated directory.

F. Operation and Maintenance Manuals

1. Operation and maintenance manuals providing comprehensive detailed information for the specific approved equipment; including approved shop drawings and catalog cuts, troubleshooting, maintenance requirements, spare part lists, sequence of operations, test results, electrical/control devices and electrical/control wiring diagram(s), bearings maintenance procedures, lubrication procedures and lubricant type.

B. Construction and Installation Procedures

1. Field test procedures.

C. Site Inspection Reports

1. Field test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15931

AIR OUTLETS AND INLETS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for air outlets and inlets.

1.02 PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, as though the Authority were a private corporation, and the latest industry standards including, but not limited to those of the entities listed below.

Air Conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
National Fire Protection Association (NFPA)

Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Unless otherwise shown on the Contract Drawings, sound levels and noise criteria for all air outlets and inlets shall not exceed the following levels measured at a location 42 inches below the center of the unit:

Noise Criterion Curve – N C	Sound Meter Readings dBA
35	40

C. All air outlets and inlets shall distribute the design flow rate of air shown on the Contract Drawings evenly over the space intended, without causing noticeable drafts or dead spots anywhere in the ventilated area.

1.03 QUALITY ASSURANCE

Air outlets and inlets, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated, fiberboard-type containers. Identify, on outside of container, type of air outlets or inlets and location to be installed. Avoid crushing or bending and prevent dirt and dust from entering and settling in devices.

B. Store air outlets and inlets, in original cartons, in clean, dry spaces and protect them from weather.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide air outlets and inlets of one of the following manufacturers, or approved equal:

Anemostat Products Div./Dynamics Corp. of America
Carnes Company, Inc.
Krueger Division of Philips Industries
Titus Products

2.02 MATERIALS

Materials for air inlets and outlets shall be aluminum or steel as shown on the Contract Drawings.

2.03 CONSTRUCTION FEATURES

A. General

Provide air outlets and inlets of type, capacity and size where shown on the Contract Drawings and as specified below.

B. Supply Diffusers

Unless otherwise shown on the Contract Drawings, provide all air diffusers with the following:

1. Multi-blade volume damper, adjustable from face of diffuser.
2. Air-equalizing deflectors, fully adjustable for horizontal to vertical air flow.
3. Removable core.

C. Linear Diffusers

1. Provide linear diffusers with fully adjustable air pattern controlling vanes, capable of deflecting the air pattern in a 180-degree radius. The air pattern shall be manually adjustable from the face of the diffuser.

2. The unit shall be capable of dampening the air flow rate without changing the air pattern or of changing the pattern without changing the air flow rate. Provide single leaf type damper with each slot opening throughout the entire diffuser length.

3. Screw holes or welded corners shall not be visible on diffusers or frames.

4. Where the diffusers require sectional installation, provide key strips in each extrusion to ensure positive alignment of all adjacent sections.

5. Provide inactive sections and mitered corners with black blankoff baffles.

D. Registers

1. Unless otherwise shown on the Contract Drawings, furnish all registers with the following:

   a. Opposed blade volume damper with key operator, adjustable through the face of the register. Damper blades shall be linked to operate in unison and shall be capable of positive positioning from fully open to fully-closed with the register installed in space.

   b. Removable core.

2. Unless otherwise shown on the Contract Drawings, provide supply registers with the following:

   a. Double deflection grilles having horizontal face bars.

   b. Multi-blade control grid at the duct branch or duct collar.

3. Provide return and exhaust registers with 40-degree horizontal fixed bars. Net effective free area of the register shall not be less than 75 percent of overall area.

E. Return Grilles

Provide return grilles with 40-degree horizontal fixed bars.

F. Transfer Grilles

Provide transfer grilles of the aluminum grid core type complete with mounting frame.

G. Dual Plenum Ceiling Diffusers for Linear Metal Type Ceiling

1. Interconnect plenums with a crossover duct sized to provide equal air distribution in both plenums.

2. Provide an oval inlet of 6-inch round equivalent size in the side of one plenum.

3. Space plenums to match the increment of the ceiling panels.

4. Provide plenum with an adjustable pattern diffuser outlet having 5/8-inch wide by approximately 46-inch long slot type opening with 1-inch wide face tie bars attached longitudinally to each side of slot opening and extending full length of the diffuser.

5. Provide diffusers to hang independently and securely so as not to transmit any vibration to the ceiling.

6. Provide adjustable pattern deflectors to have incremental air discharge pattern, from horizontal left or right to vertical.

H. Air Diffusers for Combination Light Fixtures

Air diffusers for combination light fixtures furnished and installed under Division 16 Section entitled "LIGHTING FIXTURES", shall meet the following requirements:

1. Supply air diffusers shall consist of single or dual supply plenums with crossover bridge and 3-inch high, oval, side or top air connection sized for connection to a 6-inch round flexible duct. Diffusers shall have adjustable pattern deflectors in each outlet slot and a volume damper in the inlet collar. Both adjustments shall be accessible through the diffuser outlet slot without disturbing the fixture lens or ceiling construction. Pattern deflectors shall lock positively in all set positions and shall permit a vertical discharge or a horizontal discharge pattern, the direction of which can be changed 180 degrees. Inlet static pressure and volume shall remain constant under all positions of pattern adjustment.

2. The side trim rails of the fixtures shall be continuously slotted for either supply or return air. The end trim rails shall be similarly slotted for return air through the fixture lamp cavity. Slot in the air diffuser plenum shall be compatible in size and location with the discharge slot in the side trim rails. A positioning socket or recess shall also be provided in the rail which shall receive the neck of the plenum and hold it securely in position over the slot without the use of screw-type fasteners.

3. When installed on the fixture, the highest point of the air diffuser assembly shall be not more than 7-1/2 inches above the finished ceiling and the clearance between the top of the fixture housing and the bottom of the crossover bridge shall not be less than 1/4-inch. Holding brackets designed to accept the mounting buttons on the diffuser plenum, shall be furnished on the fixture housing and shall hold the entire air diffuser assembly firmly in position on the fixture. A minimum of two such brackets shall be provided on each plenum.

4. The connection between the crossover bridge and the two diffuser plenums shall be airtight and the assembly of the air diffuser unit and the mounting of the unit on the light fixture shall be accomplished without the use of screw-type fastenings, tape or other mechanical fasteners which are not an integral part of either the lighting fixture or the air diffuser. The entire assembly shall be compatible with the proposed ceiling construction and shall provide adequate clearance for duct connections to the diffuser air inlet.

5. Dual plenum supply air diffusers shall be capable of delivering up to 180 cfm of air in a horizontal pattern with an inlet static pressure not exceeding 0.21-inch water gauge. Single plenum supply diffusers shall be capable of delivering up to 90 cfm of air in a horizontal pattern with an inlet static pressure not exceeding 0.15-inch water gauge.

6. Coordinate the design and installation details of supply air diffuser units with the lighting fixture manufacturer furnishing said fixtures under this Contract and furnish to the manufacturer all drawings, details and information required for this purpose.

7. Complete air handling lighting fixture units shall meet UL requirements for use as a cooled or heated air outlet and a return air inlet.

2.04 SHOP PAINTING

Unless otherwise shown on the Contract Drawings, finishes for all air outlets and inlets, except for linear diffusers, shall be baked white enamel. Linear diffusers shall have white anodized finishes unless otherwise shown on the Contract Drawings. Finishes shall match the approved color samples submitted.

2.05 SHOP TESTS

Test and rate all air outlets and inlets in accordance with ADC 1062. Air outlets and inlets shall bear ADC seals.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install air outlets and inlets in accordance with manufacturer's installation procedures.

B. Coordinate all Work to ensure that the installation of air outlets and inlets is not in conflict with the work specified under other Sections.

3.02 FIELD TESTS

Arrange for a qualified technical representative of the manufacturer to advise on the field tests specified in Division 15 Section entitled "TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS".

END OF SECTION

SECTION 15931

AIR OUTLETS AND INLETS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Samples

15931C01 Three samples of finishes of air outlets and inlets for approval.

Product Data

15931D01 a. Each type, model number, size, service, blade setting angle, CFM, pressure drop and accessories furnished.
b. Catalog cuts, including product performance data.
c. Floor/room designation of each air outlet and inlet.
d. Sound power levels at design flow rates.
e. Throw and drop at design flow rates.
f. Material of unit, finish and mounting details.
g. Installation procedures.
h. Shop test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15939

MOTORS AND MOTOR CONTROLLERS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for electric motors of up to 200 horsepower.

B. This Section specifies requirements for furnishing motor controllers and associated accessories needed.

C. The following related work is specified in the Division 16 Section entitled "MOTOR POWER AND CONTROL WIRING", and is not part of that required under this Section:

1. Installation of motor controllers and associated accessories (1.01 B above).
2. Field wiring between electrical components.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes and the latest industry standards including, but not limited to the entities listed below.

New York City Building Code

New York State Energy Conservation Construction Code

New Jersey Uniform Construction Code

American National Standards Institute (ANSI)

Institute of Electrical and Electronic Engineers (IEEE)

National Electrical Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

Underwriters Laboratories, Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. All motors shall be "Premium Efficiency" type, as described in NEMA MG-12.54-2. Test shall be performed in accordance with IEEE 112, Method B. Additionally, provide standard efficiency design motors for equipment that run infrequently, if specifically indicated on the Contract Drawings.

1.03 QUALITY ASSURANCE

A. Motors, motor controllers and associated accessories, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing Work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery motors (if not delivered with motor-driven equipment) with factory-installed wooden skids and lifting lugs; pack motor controllers and accessories in factory-fabricated protective containers.

B. Handle motors, motor controllers, and accessories carefully to avoid damage to components, enclosures and finish.

C. Store motors, motor controllers, and accessories in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading motors, and moving motors to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide motors and motor controllers of one of the following manufacturers, or approved equal, unless otherwise specified in other Sections:

A. Motors

1. General Electric Co.
2. Westinghouse Electric Corp.
3. Siemens-Allis Inc.
4. Reliance Electric Co.

B. Motor Controllers

1. Westinghouse Electric Corp.
2. Square D Co.
3. Allen-Bradley Co.
4. Cutler-Hammer Inc.
5. General Electric Co.

6. ABB Industrial Systems, Inc.

2.02 CONSTRUCTION FEATURES

A. Motors

1. Motor characteristics shall be as specified below unless otherwise specified in other Sections or shown on the Contract Drawings.

2. All motors, with the exception of severe duty motors as defined below, shall be designed to operate continuously at 40 degrees C ambient temperature with a service factor of 1.15, unless otherwise specified in other Sections. Severe duty motors shall have a service factor of 1.0 at 65 degrees C ambient. In rating the motors, no portion of a motor's service factor above 1.0 shall be used for the continuous operation of the motor.

3. Polyphase motors shall be NEMA MG 1 Design B torque, unless the load justifies another NEMA Design starting characteristic. Motors shall have a motor input with "Locked Rotor KVA Code Letter" specified in Tables I, II or III, as applicable. Fractional horsepower motors below 3/4 horsepower shall meet NEMA requirements for minimum torque and maximum current.

4. Motors 1/2 horsepower and larger shall be 460-volt, three-phase, 60 Hertz, squirrel cage induction type. Motors below 1/2 horsepower shall be 120-volt, single-phase, 60 Hertz, capacitor-start, induction-run or split-phase type.

5. Use open drip-proof type motors for general indoor applications. The motors shall have minimum Class "B" insulation.

6. Use totally enclosed, fan-cooled type motors for special indoor applications such as inside return air plenums, for inline direct-driven fans and when floor-mounted near hose down areas or for other applications as shown on the Contract Drawings. The motors shall have minimum Class "B" insulation.

7. Use totally enclosed, fan-cooled type motors for all outdoor applications. Motor shall be severe duty, with minimum Class "F" insulation.

8. Bearings for integral horsepower motors shall be antifriction, open type with grease fittings and shall have a minimum rated life of 125,000 hours for direct coupled motors and 25,000 hours (50,000 hours for severe duty motors) for belt or chain driven loads. Bearings for fractional horsepower motors shall be permanently sealed ball type, suitable for continuous duty.

9. Horsepower and frame relationship shall conform to NEMA MG 1 for T-frame motors.

10. The no-load sound pressure level, for high efficiency motors, based on the A-weighted scale at 3 feet when measured in accordance with IEEE 85, shall not exceed 85 dBA.

11. Provide solderless lugs of proper sizes at the ends of motor leads.

12. Where shown on the Contract Drawings, provide motors with space heaters, rated 115-volt, single-phase, sized to maintain motor internal temperature above the dew point when motor is at rest. Space heater leads shall be terminated in a box separate from the main leads.

13. All motors shall be labeled by the manufacturer with NEMA minimum efficiency marking standard in accordance with NEMA standard MG-1-12.53b.

14. Where a solid state motor starter is called for, provide verification that the submitted motor is suitable for operation with a solid state motor starter. All motor manufacturer's special enhancement requirements to solid state motor starters shall be incorporated into the solid state starter by the starter's manufacturer.

15. All motors shall have minimum power factors, at 100% full load, as follows:

    a. Single-Phase Induction Motors; Squirrel-Cage Rotor

       1/20 to 1 hp, power factor .68

       Above 1 to 10 hp, power factor .82

    b. Polyphase Induction Motors; Squirrel-Cage Rotor

       1 to 10 hp, power factor .85

       Above 10 to 50 hp, power factor .89

    c. Polyphase Induction Motors; Phase-Wound Rotors

       5 to 20 hp, power factor .86

       Above 20 to 100 hp, power factor .87

B. Motor Controllers

1. Motor controllers and controls shall be as specified below unless otherwise specified in other Sections or shown on the Contract Drawings.

2. All motor controllers shall be combination controllers suitable for wall mounting.

3. All controllers shall comply with the following:

    a. Controllers for motors 1/2 horsepower and larger shall be combination, magnetic, full voltage across-the-line starting, with circuit breaker, designed for operation on 460-volt or 208-volt, 3-phase, 60 Hertz service. Single speed controllers shall be provided with three overload relays, one in each phase.

       (1) When thermal overload devices are provided they shall be ambient temperature compensated. The coil interrupting overload contacts shall be on the phase side of the coil.

       (2) Provide two additional spare auxiliary contacts in each controller.

       (3) Two-speed starters shall have six overload relays, one in each phase for the two speeds.

    b. Controllers for motors less than 1/2 horsepower shall be of the toggle, switch, manual type with integral overload protection and pilot light in the cover, and shall be designed for 120-volt, single-phase, 60 Hertz service. Where interlocks or automatic controls are required, provide magnetic across-the-line combination starters.

c. All magnetic controllers subject to manual start shall have momentary contact start-stop pushbuttons, pilot light and reset button built into cover. All magnetic controllers requiring electrical interlocks or automatic control shall have "Hand-Off-Automatic" switch, pilot light, stop and reset buttons built into the cover, unless subject to cycling control, in which case the pilot light shall be omitted.

(1) Hand position on "Hand-Off-Automatic" switches shall permit local starting of the motor by shunting all automatic controls. "Hand" position shall not bypass safety controls.

(2) Combination controllers shall be capable of being locked in the open position. All controllers shall have manual reset on the overload relay.

d. Where required to prevent simultaneous starting of motors, provide interlocked controllers with time delay devices.

e. All individually mounted motor controllers, installed indoors, shall be furnished in a NEMA Type 1 general purpose enclosure. All individually mounted motor controllers, installed indoors in an industrial environment, shall be furnished in a NEMA ICS 6, Type 12 enclosure.

f. Controllers mounted outdoors shall be furnished in NEMA ICS6 Type 4X watertight enclosures.

g. The minimum controller size, for three-phase motors, shall be NEMA ICS 2, Size 1.

h. In addition to NFPA 70 (NEC) requirements for safety disconnect switches, where controllers are not directly adjacent to the motors they control, or where a safety disconnect switch is not specified to be furnished with motor-driven equipment, a heavy-duty, unfused disconnect switch, arranged for being padlocked in the open position, and also capable of interrupting the motor locked rotor current, shall be furnished for installation within sight of the motor.

i. All controllers for 460-volt or 208-volt service shall have 460/120 volt or 208/120 volt, respectively fused transformers built-in in each controller housing to serve all control circuits within the controller. Each controller subject to electrical interlock and/or automatic control shall have the necessary auxiliary contacts to perform the required operations. One set of terminals shall be provided for each control circuit.

j. Where interposing relays are required, they shall be furnished in separate enclosures adjacent to the controllers.

k. Where controllers are interlocked, a separate disconnect switch shall be mounted adjacent to the lead controller in order to disconnect all control voltages to the controllers.

l. All parts subject to wear or arcing, shall be renewable.

m. All electrical control devices shall be heavy-duty oil tight construction.

n. All motor controllers, disconnect devices and other control devices shall be labeled as to use and function, utilizing engraved plastic nameplates with white letters on black background. Inscriptions shall be as shown on the Contract Drawings.

C. Electro-Mechanical Devices

Electro-mechanical devices required for interlocking or sequencing or safety control of motors such as pneumatic solenoids, float switches, high and low limit switches, and aquastats, are furnished and installed under other Sections of the Specifications.

D. Factory Wired Equipment

1. Equipment with Factory Wired Motors (FWM) shall have all starting and control equipment furnished and installed with motors, and completely wired unless otherwise specified in other Sections or shown on the Contract Drawings.

2. Factory Wired Control Panels (FWCP) shown on the Contract Drawings shall include combination controllers with disconnect switches.

3. Provide all motor control panels, including the hinged door, fabricated of minimum 12-gauge sheet steel, properly finished to prevent corrosion. As a minimum, the cabinets shall be thoroughly cleaned, primed with zinc phosphate and finished with two coats of baked enamel or an equivalent finish coat, or as otherwise specified on the Contract Drawings. Control devices shall be mounted on the door, completely wired and neatly cabled back to terminal strips. A four-inch minimum wiring gutter on all four sides of the panel shall be provided.

4. Where two or more controllers in a single enclosure are grouped for duplex or triplex operation, each controller shall have a control transformer with secondary pullout fuses. Each controller fused disconnect switch shall be capable of de-energizing its associated control transformer and controller circuit.

5. Devices shall have individual nameplates plus a nameplate for a group indicating the motor or motors controlled. Panels shall be degreased and painted with zinc chromate primer and factory-finished grey enamel finish coat.

2.03 SHOP TESTS

Minimum efficiency values of furnished motors shall be confirmed by testing in accordance with IEEE-112, Method B, to be in conformance with NEMA MG-1 tables of efficiencies applicable to premiums efficiency motors, or to standard efficiency motors as is applicable.

PART 3. EXECUTION

3.01 INSTALLATION

A. Provide non-adjustable base for motors directly connected to driven equipment and adjustable sliding base for motors connected to driven equipment via belt or chain.

B. Provide slotted mounting holes in base for fractional horsepower motors.

C. Install independently mounted motor control devices in accordance with manufacturer's written instructions, and in compliance with applicable requirements of NEC, UL and NEMA standards.

D. Locate motor controllers as indicated, and within sight of respective controlled motors.

E. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

END OF SECTION

SECTION 15939

MOTORS AND MOTOR CONTROLLERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Product Data

15939D01 Submissions shall be clearly identified with the pertinent motor numbers and the proper control equipment to be wired into the control circuits.
a. Motor schedules with full nameplate data including, at a minimum, horsepower, voltage, FLA, LRA, speed (rpm), efficiency, phase, frequency, type of insulation.
b. Motor controller schedules.
c. Product data for motors, motor controllers, and all other products specified in this Section. Include dimensions of selected models, required clearances, ratings, operating data, and data on features and components.
d. Catalog cuts, including product performance data.
e. Power and control wiring diagrams showing connections to power panels, feeders and equipment. Differentiate between manufacturer-installed and field-installed portions of wiring.
f. Coordination curves of overcurrent protection equipment and interrupting capacities of equipment.
g. Listing of proposed inscriptions for labeling all motor controllers, disconnect devices and other control devices.
h. Installation procedures.
i. Maintenance data.
j. Shop test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15940

VIBRATION ISOLATION AND CONTROL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for vibration isolation and control, applicable to piping, ductwork and equipment.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State, and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

Air-Conditioning and Refrigeration Institute (ARI)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
American Society of Plumbing Engineers (ASPE)
American Society of Mechanical Engineers (ASME)
American Society for Testing and Materials (ASTM)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Vibration isolation and control devices, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver isolators in manufacturer's original, unopened, protective packaging. Packaging and packed devices shall be both labeled and tagged to properly identify device and its proper location for installation on the construction site.

B. Store devices in original packaging in clean, dry spaces and protect them from weather.

C. Inspect all isolators for damage before moving them from storage to a location for installation on the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide vibration isolation systems of one of the following manufacturers, or approved equal:

Mason Industries Inc.
Vibration Mountings and Controls/Korfund Dynamics
Vibration Eliminator Co., Inc.
Amber-Booth Co.

All isolation systems, including mountings and hangers, shall be designed and furnished by the same manufacturer, except for equipment furnished with internal isolation.

2.02 MATERIALS

All concrete used in inertia bases shall be Class B (3000 to 4000 psi strength specified in applicable Section of Division 3), steel reinforced for load and temperature stresses.

2.03 CONSTRUCTION FEATURES

A. General

1. Piping and Ductwork Isolation Types

Unless otherwise shown on the Contract Drawings, selection of isolation types for piping and ductwork shall be as specified in 3.02 C and D.

2. Equipment Isolation Systems

Unless otherwise shown on the Contract Drawings, select vibration isolation systems for all mechanical equipment having vibration/motion, including but not limited to the following equipment:

Refrigeration machines
Reciprocating compressors and engines
Air-cooled condensers or condensing units
Boilers and steam generating units
Pumps
Cooling towers
Fans, air handling equipment and unit heaters
Packaged air-conditioning equipment
Packaged roof top air-conditioning units (if not provided with internal isolation)
Packaged emergency generators

a. Systems selected shall be of the proper types and design such that they are compatible with the building structural framing spans and floor construction and provide the isolation and deflection required.

b. Systems selected shall comply with ASHRAE 1984 Systems Volume, Chapter 32, and shall be in accordance with recommendations of equipment manufacturers, in conjunction with the vibration isolator manufacturer.

B. *Isolation Mountings*

1. Elastomer isolators shall have a stiffness range of 30 to 70 durometers. All metal surfaces shall be covered with the elastomer material to avoid corrosion. Mountings shall be Mason type ND, or approved equal.

2. Spring isolators shall be provided with an elastomer acoustical barrier designed with a horizontal stiffness of at least 75 percent of the vertical stiffness and a 50 percent travel capability beyond rated load. All isolators shall have leveling bolts for rigid bolting to the equipment. Mountings shall be Mason type SLF, or approved equal.

3. Restrained spring isolators shall be the same as the spring isolators specified above, except a housing shall be provided that includes vertical limit stops to prevent spring extension when weight is removed. Mountings shall be Mason type SLR, or approved equal.

C. Isolation Hangers

1. Isolation hangers (regular) shall have elastomer elements, springs or a combination of springs and elastomer elements. Hangers shall be designed for a minimum of 30 degrees angular hanger rod misalignment and a 50 percent travel capability beyond rated load. Means shall be provided to prevent direct contact of hanger rod with housing and short-circuiting the spring vibration dampening effect. Hangers shall be Mason type 30N, or approved equal.

2. Position (precompressed) isolation hangers shall be the same as the regular isolation hangers specified above, except that the hangers shall be precompressed to the rated deflection so as to keep the piping at a fixed elevation during installation. The hangers shall be provided with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Hangers shall be Mason type PC30N, or approved equal.

3. Ductwork isolation hangers shall have springs in elastomer cups and provisions to attach the hanger housings to the flat iron duct straps. Provide a steel washer inside the cup to properly distribute the load on the elastomer and prevent its extrusion. Hangers shall be designed for a minimum of 30 degrees angular hanger rod misalignment and a 50 percent travel capability beyond rated load. Hangers shall be Mason type W30, or approved equal.

D. Flexible Pipe Connectors

1. Flexible synthetic elastomer connectors shall be manufactured of multiple plies of nylon tire cord fabric and synthetic elastomers, both molded and cured in hydraulic "rubber" presses. No steel wire or rings shall be used as pressure reinforcement. Connectors up to and including 2-inch diameter shall be hose type, with threaded ends and 12 inches in length. Connectors 2 1/2 inches and larger shall be arched or spherical type in standard lengths and shall be manufactured with floating steel flanges recessed to lock the connector's raised face elastomer flanges. Connectors shall be rated minimum 150 psi at 220 degrees F. Connectors shall be properly pre-extended and restrained as recommended by the manufacturer to prevent additional elongation under pressure. Connectors shall be Mason type MFNEC, MFTFU or MFTNC (as applicable), or approved equal.

2. Where temperature of the fluid exceeds 220 degrees F, flexible stainless steel hoses shall be used. Flexible hoses shall be stainless steel braid with carbon steel fittings. Sizes 2 1/2 inches and larger shall be flanged. Sizes 2 inches and smaller shall have male nipples. Lengths shall be as follows:

Flanged		Male Nipples	
2 1/2 x 13	8 x 22		
3 x 14	10 x 26	1/2 x 9	1 1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
	14 x 30	1 x 11	
6 x 20	16 x 32	1 1/4 x 12	

Flexible stainless steel hoses shall be Mason type BSS, or approved equal.

E. Equipment Bases

1. Structural Steel Bases and Rails

a. Provide structural steel members welded to height saving brackets for spring isolator attachments to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strain in the equipment. Inverted saddles shall be Mason type ICS, or approved equal.

b. Where the equipment requires a complete supplementary base, provide a fabricated structural steel base. Structural steel bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases that may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base "ells". All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth shall not exceed 14 inches provided that deflection and misalignment are kept within acceptable limits. Height saving brackets shall be employed in all spring isolator mounting locations to provide a base clearance of one inch. Bases shall be Mason type WF, or approved equal.

2. Concrete Inertia Bases

Provide concrete inertia bases formed with rectangular structural channel concrete forms. Bases for split case pumps shall be large enough to provide support for suction and discharge base "ells". The base depth shall not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. In general, base depths shall be a minimum of 1/12th of longest dimension of the base, but not less than 6 inches. Forms shall include minimum concrete reinforcement consisting of half-inch bars or angles welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as required by the structural conditions. Forms shall be furnished with drilled members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all spring mounting locations to maintain a one-inch clearance below the base. Bases shall be Mason type K, or approved equal.

3. Curb Type Isolation Bases for Rooftop Equipment

For rooftop equipment, not furnished with internal vibration isolators, provide curb type vibration isolation aluminum bases that fit over the roof curb and under the vibration isolated equipment. The extruded aluminum top member shall overlap the bottom member to provide water runoff independent of the seal. The aluminum members shall house cadmium-plated springs having a one-inch minimum deflection with 50 percent additional travel to "solid". Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4 inch, so as not to interfere with the isolation action except in high winds. The weather seal shall consist of continuous, closed cell, sponge materials both above and below the base and a waterproof, flexible, duct like, synthetic elastomer connection joining the outside perimeter of the aluminum members. Foam or other contact seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum. Curb type isolation bases shall be Mason type CMAB, or approved equal.

2.04 SHOP PAINTING

A. Corrosion resistance coatings shall be factory-applied to all vibration control devices and isolators. No field applications will be permitted. Shop prime coats, compatible with architectural treatment field paintings, shall be applied after the applications of corrosion resistance coatings are completed.

B. Where exposed to outdoors, steel parts shall be hot-dipped galvanized and springs shall be cadmium plated.

PART 3. EXECUTION

3.01 PREPARATION

A. Coordinate all trades in the use of approved detailed shop drawing templates for all equipment foundations and supports. Verify that all bolts, anchors, supports and appurtenances, required for proper installation of the equipment and isolators, are in place and that the necessary concrete and steel are in place.

B. Do not proceed with installation of isolation devices and their supports and anchors until required permanent building structural steel and concrete are in place. Correct inadequacies including proper placement of inserts, anchors and other building structural attachments.

3.02 INSTALLATION

A. General

1. Install all vibration isolation systems in accordance with manufacturer's installation procedures and ASHRAE recommendations.
2. Perform all concrete work required for installation of vibration isolation systems.
3. Erect all floor-mounted equipment and pipe supports on 4-inch high concrete pads extending 4 inches beyond the completed floor area of the equipment. Mount vibration-attenuating devices on 4-inch high concrete pads unless otherwise shown on the Contract Drawings.
4. Install isolation systems so as not to physically interfere with operation of mechanical equipment or access for maintenance.
5. Provide inspection services by vibration isolation systems manufacturer's representative for final installation. Provide written report that installation is in accordance with this Section and manufacturer's recommendations.

B. Equipment Isolation

1. Set accessory and isolator steel bases for required clearance between concrete pads and equipment base.
2. Utilize suitable hold-downs and limit-stop devices to maintain equipment isolators at correct static deflection while connecting piping and ductwork. After pipe, conduit, and duct hangers are installed and adjusted, equipment shall be permitted to float free. Limit-stops shall be out of contact during start-up and operation of equipment.

C. Piping Isolation

1. Suspended Piping

a. Install isolation hangers for all piping in equipment rooms and for 50 feet from a connection to equipment, where the 50-foot length extends beyond the equipment room.

b. A minimum of the three closest hangers to an equipment connection shall provide the same deflection as the equipment isolation devices, with a maximum of 2-inch deflection.

c. The closest two hangers to an equipment connection shall be position (or precompressed) isolation hangers, adjusted to prevent load transfer to the equipment flanges when the pipe system is filled or drained.

d. The remaining isolation hangers shall be regular isolation hangers with a 0.75-inch deflection for piping up to 8 inches in size. Position isolation type hangers shall be used for piping 8 inches in size and larger.

2. Floor Supported Piping

a. Isolate floor-supported piping from the building structure by floor mounting spring isolators.

b. The two supports closest to an equipment connection shall consist of restrained spring isolators with a blocking feature that prevents load transfer to equipment flanges as the piping is filled or drained.

c. Provide a slide plate of Teflon or graphite where large thermal movement will result.

3. Flexible Pipe Connectors

a. Provide all piping connections to rotating and reciprocating equipment with flexible pipe connectors.

b. Install connectors on the equipment side of the shut-off valves.

c. Install connectors in accordance with the weight distribution of the equipment to provide a stable mounting decoupled system.

d. Install each connector so that the equipment support base remains level during deflection.

e. Incorporate end thrust restraint into the design of all connectors or add end thrust-restraint to piping systems, externally.

D. Ductwork Isolation

All discharge ductwork for a distance of 50 feet from the connected equipment shall be isolated from the building structure by ductwork isolation hangers. Floor supported ductwork shall be isolated from the building structure by floor-mounting restrained spring isolators.

3.03 FIELD TESTS

A. After installation, the Engineer may perform tests of vibration isolation systems to check deflections.

B. Make adjustments, replacements and alterations as necessary to reduce transmitted amplitude to no more than plus or minus 10 percent of the originating equipment vibration amplitudes, over the full range of operating speeds and loads.

END OF SECTION

SECTION 15940

VIBRATION ISOLATION AND CONTROL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

15940A01 a. Assembly-type shop drawings for each type of isolator indicating dimensions of selected models, required clearances and methods of assembly and field installation of all components.
b. Detailed shop drawings and templates for all equipment foundations and supports indicating all required bolts, anchors, supports and appurtenances required for proper installation of the isolators at the equipment, and the required concrete and steel work.
c. Shop drawings showing isolator locations, load on each isolator, deflection, inertia slab dimensions of selected models, details of supports and required field installation instructions.
d. Schedules showing manufacturer's figure number, size, location, and any specific features for each vibration isolation device.
e. Catalog cuts, including product performance data, of all furnished vibration isolation devices.
f. Installation procedures for each type of isolation device.
g. Maintenance data for each type of isolation device.

Inspection Reports

15940O01 Certified installation inspection report by isolation systems manufacturer.

st results.NDIX "A"

DIVISION 15

SECTION 15945

HVAC INSULATION

PART 1. GENERAL

1.01 SUMMARY

This Section specifies insulation requirements for heating, ventilation, and air-conditioning (HVAC) sheet metal ductwork, piping and equipment.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State, and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to, the entities listed below.

New York City Building Code
New York State Energy Conservation Construction Code
New Jersey Uniform Construction Code
American Society of Heating, Refrigerating and Air-Conditioning Engineers
American Society for Testing and Materials (ASTM)
National Fire Protection Association (NFPA)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. All insulation, including jackets or facings, adhesives, mastics, cements, tapes and glass cloth for fittings shall have composite fire and smoke hazard ratings as tested by ASTM E 84, NFPA 255, and UL 723 procedures, not exceeding a "Flame Spread" of 25 and "Smoke Developed" of 50.

C. Any treatment of jackets or facings to impart flame and smoke safety shall be permanent. The use of water-soluble treatments is prohibited.

1.03 QUALITY ASSURANCE

A. Insulation materials and accessories, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to the construction site in manufacturer's sealed containers with manufacturer's stamp or label affixed, showing fire hazard indexes of products.

B. All insulation components shall be stored at the construction site on pallets or raised platforms with suitable shed enclosures to protect against foreign matter and rain.

C. Before moving insulation materials from storage to the construction site, all insulation sections and component materials shall be inspected for damage. Remove damaged materials from the construction site and replace damaged materials, to the satisfaction of the Engineer, at no additional cost to the Authority.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide insulation materials of one of the following manufacturers, or approved equal:

Schuller International, Inc., Mechanical Insulations Div.
Certain - Teed Corp./Insulation Group
Owens - Corning Fiberglas Corp.
Knauf Fiber Glass

As standard, catalog numbers/trade names of Schuller are indicated herein as basis for quality of insulation desired.

2.02 MATERIALS

A. Sheet Metal Ductwork Insulation

1. HVAC Supply, Return and Transfer Air Ductwork - concealed in hung ceilings, shafts and furred spaces.

a. Insulation shall be two-inch thick flexible blanket fiberglass with factory-applied foil-scrim-kraft (FSK) facing.

b. Flexible blanket fiberglass insulation shall conform with ASTM C 553, Type I, Class B-3.

c. The insulation shall be Schuller "MICROLITE" Type 75 ductwrap with FSK facing, or approved equal.

2. HVAC Supply, Return, Transfer Air, Outside Air Supply Ductwork and Plenums-exposed in mechanical equipment rooms, crawl spaces, all unconditioned areas, and outdoors

   a. Insulation shall be 1-1/2-inch thick rigid fiberglass board with factory-applied all purpose (AP) white facing for indoors, and two-inch thick for outdoors.

   b. Rigid fiberglass board insulation shall conform with ASTM C 612, Class 1 except that the density shall not be less than 6 lbs. per cubic foot.

   c. The insulation shall be Schuller "817 SPIN-GLAS" with AP white facing, or approved equal.

   d. Finish and weatherproofing are specified in 3.02 B.2.

3. Kitchen Exhaust Duct, Boiler Breeching, and Kitchen Exhaust Fan Insulation

   a. Insulation shall be two-inch thick calcium silicate block.

   b. Calcium silicate block insulation shall conform with ASTM C 533, Type I, and shall be Schuller "THERMO-12 GOLD" with 200 psi compression strength, or approved equal.

   c. Finish is specified in 3.02 B.3.

4. Insulation for Built-Up Central Station HV and HVAC Units

   a. Casing insulation shall be two-inch thick fiberglass duct liner with an acrylic surface coating.

   b. Insulation shall have a density of 1.5 lbs. per cubic foot with a thermal conductivity k = 0.25 at 75 degrees F mean temperature and suitable for air velocities up to 5000 fpm. Noise reduction coefficient (NCR) of insulation shall be 0.7 or greater with type A mounting, in accordance with ASTM Std. E 795.

   c. Insulation shall be Schuller "PERMACOTE LINACOUSTIC STANDARD", or approved equal.

B. HVAC Piping Insulation

1. Insulation Thickness

PIPE, FITTINGS AND VALVES
Insulation Minimum Thickness (inches)

		PIPE SIZES (NPS)				
Piping System	Fluid Temp Range, Deg. F	Run-Out* Up to 2"	Up to2"	2-1/2" to 4"	5"-6"	8" and Larger
	Heating Systems (**)					
High Temp Hot Water High Press. Steam	306-450	1.5	2.5	3.0	3.5	3.5
Medium Press. Steam	251-305	1.5	2.5	2.5	3.0	3.5
Low Press. Steam Heating Hot Water	201-250	1.0	1.5	2.0	2.0	2.5
Steam	Any	1.0	1.5	2.0	2.0	2.5

Condensate incl. Drip Assembly (For Feed Water)						
		Cooling Systems				
Chilled Water Make-up, City & Cold Water	40-60	0.5	1.0	1.0	1.0	1.0
Refrigerant	Below 40	1.0	1.5	1.5	1.5	1.5

*Maximum Length 12 ft; above 12 ft. length, insulation thickness shall comply with adjacent columns.

**Heating Systems in outdoor locations shall have an additional thickness of 1/2-inch insulation above the thickness specified in this TABLE for indoor locations.

2. All Heating and Cooling Systems - Indoor Locations

   a. Insulation shall be molded fiberglass insulation with factory-applied all purpose (AP) facing or aluminum jacket (ASTM B 209, 3003 Alloy, H-14 temper) as specified in c. and d., below.

   b. Molded fiberglass insulation shall conform with ASTM C 547, Class 1.

   c. Insulation, except for High Temperature Hot Water piping, shall be Schuller "MICRO-LOK" with APT facing, or approved equal.

   d. For High Temperature Hot Water piping, provide 0.016-inch thick aluminum jacket for pipes 2-1/2 inches and larger, and 0.010-inch thick aluminum jacket for pipes 2 inches and smaller, with a built-in isolation felt.

   e. Fitting, valve, and flange insulation requirements are specified in 3.02 C.1.

3. Heating Systems - Outdoor Locations

   a. Insulation shall be calcium silicate with aluminum jacket (ASTM B 209, 3003 Alloy, H-14 Temper).

   b. Calcium silicate insulation shall conform with ASTM C 533, Type I, and shall be Schuller "THERMO-12 GOLD" with 200 psi compression strength, or approved equal.

   c. Insulation jacket shall be 0.016-inch thick aluminum for pipes 2-1/2 inches and larger, and 0.010-inch thick for pipes 2 inches and smaller with a built-in isolation felt. All seams and joints shall be weatherproof.

4. Cooling Systems - Outdoor Locations

   a. Insulation shall be molded fiberglass with aluminum jacket (ASTM B 209, 3003 Alloy, H-14 Temper).

   b. Molded fiberglass insulation shall conform with ASTM C 547, Class 1, and shall be Schuller "MICRO-LOK" with APT facing, or approved equal.

   c. Insulation jacket shall be 0.016-inch thick aluminum for pipes 2-1/2 inches and larger, and 0.010-inch thick for pipes 2 inches and smaller with a built-in isolation felt. All seams and joints shall be weatherproof.

5. Emergency Generator Exhaust Piping, Tail Pipe Exhaust Ductwork, and Fan Insulation

a. Insulation shall be four-inch minimum thickness and shall achieve a resulting operating exterior surface temperature not to exceed 150 degrees F.

b. Insulation shall be calcium silicate with aluminum jacket for piping and ductwork or with finish specified in 3.02 C.2 for fittings, silencers and exhaust fans.

c. Calcium silicate insulation shall conform with ASTM C 533, Type I, and shall be Schuller "THERMO-12 GOLD" with 200 psi compression strength, or approved equal.

d. Insulation jacket shall be 0.016-inch aluminum, factory-applied, with a built-in isolation felt. All seams and joints shall be sealed.

C. Equipment Insulation

1. Insulation Thickness

		Insulation	
Equipment	Fluid Temp., Degrees F	Thickness (inches)	Material Type
Steam Fash Tank and Condensate	Up to 275	2	A
Compression or Expansion Tanks for Heating	Up to 250	2	A
Hot Water Exchanger - Water to Water	Up to 375	3	A
Heat Exchanger - Steam to Water	Up to 375	3	A
Hot Water Generator	Up to 375	3	A
Expansion Tank - Chilled Water	Up to 55	2	A
Refrigerant Equipment	Up to 40	1.5	A
Hot Water Pumps	Up to 250	3	B
Chilled Water Pumps	Up to 55	3	B

2. Insulation Material

a. Type A: Calcium silicate, curved or scored block insulation

Calcium silicate block shall conform with ASTM C 533, Type I, and shall be Schuller "THERMO-12 GOLD" with 200 psi compression strength, or approved equal.

b. Type B: Rigid fiberglass board insulation

Rigid fiberglass board insulation shall conform with ASTM C 612, Class 1 except that the density shall not be less than 6 lbs. per cubic foot. The insulation shall be Schuller "817 SPIN-GLAS", or approved equal.

PART 3. EXECUTION

3.01 PREPARATION

A. Duct insulation shall be applied after testing of duct system has been completed and approved by the Engineer. Piping insulation shall be applied only after the piping systems have been hydrostatically tested and approved by the Engineer.

B. Install insulation subsequent to installation of heat tracing and any coating or painting.

C. Surfaces shall be clean of rust, scale, dirt, dust, grease and other foreign matter and shall be dry before application of insulation.

D. All metal fasteners shall be made of galvanized steel or other approved corrosion-resistant materials.

3.02 INSTALLATION

A. General

1. Install insulation products in accordance with this Section and manufacturer's installation procedures.

2. Install insulation materials with smooth and even surfaces. Insulation shall be continuous and be carefully fitted with side and end joints butted tightly and staggered. Install each continuous insulation course with full-length units of insulation, with single cut piece to complete run. Do not use multiple cut pieces or scraps abutting each other.

3. All openings, joints, laps and end strips shall be sealed against moisture penetration with fire-retardant vapor barrier.

4. Maintain integrity of vapor barrier jackets on insulation, and protect to prevent puncture or other damage. Staples and similar fastening methods are prohibited for securing vapor barriers on insulation.

5. Extend insulation without interruption through walls, floors, roofs, ceilings and similar penetrations.

6. Where ducts and pipes pass through walls, floors or partitions, the space around the insulated duct or pipe shall be sealed with Thermafiber semi-rigid blanket manufactured by U.S. Gypsum, or approved equal.

7. For double layer insulation, apply each layer of insulation using staggered joint method. Apply each layer of insulation separately.

8. Do not apply seal or cement until all previous application of cements and adhesives have thoroughly dried.

9. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with insulation cement of sufficient thickness to remove surface irregularities and properly embed netting.

10. The finish, including any vapor barrier treatment, shall lap adjacent sections at both the transverse and longitudinal joints.

11. When supplementary load-bearing material is required at hangers and supports to resist compression of the insulation, the load-bearing thermal insulation shall be the same thickness as the normal pipe thermal insulation. The material shall conform to the flame spread and smoke developed ratings as specified in 1.02 B.

12. Do not insulate boiler manholes or equipment end head pivots, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

13. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance. These shall include metal vessel covers, fasteners, flanges, frames and accessories.

14. All ductwork angle joints and reinforcement shall be insulated.

15. Where internal ductwork insulation is required, the exterior duct insulation may be omitted, provided that the equivalent "R" factor for the internal duct insulation is the same as the external duct insulation requirements.

16. Valves, fittings, strainers, and other piping appurtenances shall be insulated to match those of the systems to which they are connected.

17. All insulation and exterior jackets that are damaged shall be replaced with new material as specified, to the satisfaction of the Engineer.

18. Insulation on all piping at hangers and supports shall be provided with galvanized protection shields or saddles to prevent crushing of insulation and damage to vapor barrier.

19. Hangers and supports that are directly connected to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation..

B. Sheet Metal Ductwork Insulation

1. Flexible (Blanket) Fiberglass Insulation

a. Wrap insulation tightly on ductwork with all transverse joints butted and longitudinal joints overlapped a minimum of 2 inches.

b. Seal all joints with 3-inch wide vapor barrier strips using an approved adhesive. All cuts and tears shall be sealed with strips of vapor barrier jacket applied with adhesive.

c. Secure insulation in place with 18-gauge copper clad wire loops, 12 inches on centers. All joints shall be lapped and sealed in place with Foster (H.B. Fuller Co./Foster Products Div.) "85-20" adhesive, or approved equal. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.

d. In addition to the requirements of a, b, and c above, secure all ductwork larger than 36 inches in width or depth with welded or adhesive type clips on top and bottom or sides of duct, spaced 18 inches on centers along the center line of duct. Cut off exposed portion of fastening pin as close to the clip as possible and seal with 3-inch wide vapor barrier with Foster "85-20" adhesive, or approved equal.

2. Rigid Fiberglass Board Insulation

a. All insulation shall be applied with edges tightly butted.

b. Impale insulation over stick clips or pins welded to duct with protruding ends of pins cut off flush, after the stick clips have been applied.

c. Spacing of pins, to hold insulation firmly in place, shall be a minimum of one pin per square foot.

d. Seal all joints and penetrations with a three-inch wide strip of the same material, applied with approved adhesive to both surfaces.

e. Where welded pins cannot be installed, the insulation shall be secured to the duct with approved adhesive and 18-gauge copper clad wire loops.

f. Finish

Apply a tack coat of approved adhesive on all corners. Embed reinforcing mesh into wet adhesive and smooth out to eliminate wrinkles. Overlap all reinforcing mesh seams a minimum of two inches. Apply finish coat of approved mastic to entire reinforcing mesh fabric.

g. Weatherproofing of Outdoor Ductwork

(1) Apply a coat of Schuller "INSULKOTE PRIMER E" to duct surface.

(2) Install a one inch galvanized steel wire mesh tightly stretched and secured over the duct insulation. All steel mesh edges shall be bound together with wire.

(3) Apply two successive 1/8-inch thick coats of Schuller "INSULKOTE ET". Embed coating completely and cover all of the wire mesh.

3. Calcium Silicate Block Insulation

a. Insulation shall be securely banded in place with tightly butted joints, staggered and secured with 12-gauge annealed stainless steel wire, 12 inches on centers. Where required, provide welded studs, clips or angles as anchors for wires.

b. Finish

(1) Over the insulation install a one-inch hexagonal copper clad steel wire mesh tightly stretched in place and secured by wiring to anchors. All steel mesh edges shall be bound together with wire.

(2) Apply two coats of 1/4-inch thick hydraulic insulating finish cement trowelled to a smooth finish.

4. Duct Liner for Built-Up Central Station HV And HVAC Units

a. Insulation shall be installed on the inside surfaces of the unit. All metal to metal contacts and joints shall be sealed with a continuous bead of an approved sealant.

b. Apply insulation to interior of casing with 100 percent coverage of an approved adhesive.

c. The acrylic-coated surface of the liner shall face the air stream. All joints shall be snug and neatly butted. Insulation shall be fastened to casing interior with mechanical fasteners spaced 12 inches on centers. All mechanical fasteners shall be flush with the perforated liner surface, and coated.

d. All exposed edges and joints shall be sealed with approved adhesive and reinforced with fiberglass mesh. A sheet metal nosing shall be installed on all leading edges of the liner.

e. Install a galvanized steel perforated panel over the entire interior surface secured with the insulation mechanical fasteners.

C. Piping Insulation

1. Molded Fiberglass Insulation

a. Longitudinal lap joints and butt joints shall be sealed with approved adhesive. Butt joints shall be wrapped with a minimum three-inch wide strip of same material as pipe jacket.

b. Fittings, valves, flanges and accessories shall be insulated with compressed fiberglass of two lbs. per cubic foot density and of the same thickness as pipe insulation, wired in place with 18-gauge galvanized steel wire. Apply a uniform coat of fire retardant vapor barrier coating to the entire surface, then cover with a factory-fabricated pre-formed insulated fitting cover, with sealed joints. The fire retardant vapor barrier shall be compatible with said insulation cover material.

c. For high temperature hot water systems in indoor locations, apply outer metal jacket over the insulation. All seams and joints shall be waterproof. Fittings, valves and flanges shall be covered with either a fabricated metal jacket or matching aluminum fitted cover, with sealed joints.

d. For cooling systems in outdoor locations, apply outer metal jacket over insulation. All seams and joints shall be weatherproof. Fittings, valves, flanges and accessories shall be covered with either a fabricated metal jacket or matching aluminum fitted cover, with sealed weatherproof joints.

2. Calcium Silicate Insulation

a. Circumferential and longitudinal joints shall be tightly butted and the half sections wired in place with 16-gauge stainless steel wire, 12 inches on centers. Where multi-layer application is required, all joints shall be staggered and the outer layers wired on as specified above.

b. Fittings, valves, flanges, and accessories including emergency generator exhaust components, shall be insulated with mitered sections of same material and thickness as pipe insulation, wired in place with 18-gauge galvanized wire. Apply an exterior coat of insulating cement with an embedded layer of fiberglass tape.

c. Apply outer metal jacket over the insulation. All seams and joints of jacket shall be weatherproofed for outdoor location and sealed for indoor location.

D. Equipment Insulation

1. Type A

a. Cut, score or miter calcium silicate insulation to fit contour of equipment and secure with 1/2-inch by 0.015-inch galvanized steel bands or 16-gauge galvanized wire, 12 inches on centers.

b. Weld pins or stick clips spaced 18 inches on centers may be used on flat surfaces.

c. Provide stationary anchors for all wires and bands.

d. Stagger all joints and fill all small voids with insulating cement.

e. Over the insulation, one-inch galvanized wire mesh shall be tightly stretched in place over the entire surface and finished with 1/4-inch thick coat of insulating cement trowelled to a hard and smooth finish.

2. Type B

Insulate pumps with removable aluminum boxes, insulated with 3-inch insulation, mechanically fastened to the metal enclosure. All joints and exposed edges shall be sealed and reinforced with a glass cloth and approved adhesive. An aluminum nosing shall be installed on all exposed edges of the enclosure to protect the insulation.

Removable aluminum boxes shall be of required size to clear all components of the pumps. All holes and slots shall have hemmed edges.

END OF SECTION

SECTION 15945

HVAC INSULATION

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

15945B01 a. Catalog cuts of insulation.
b. Product performance data for each type of insulation.
c. Schedule showing product number, k-value, material thickness and furnished accessories for each HVAC system requiring insulation.
d. Installation procedures.

Samples

15945C01 Sample of each insulation type required. Affix label on sample, completely describing product.

END OF APPENDIX "A"

DIVISION 15

SECTION 15992

TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for testing, adjusting and balancing of all air and hydronic fluid distribution systems, including the equipment and devices associated with each system.

B. The Work includes setting speed and flow, adjusting equipment and devices installed for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the mechanical installations specified in other Sections of the Specifications.

C. The following related work is specified in other Sections of the Specifications, and is not part of the Work of this Section:

1. Installation and start-up of equipment and devices to be tested, adjusted, and balanced.
2. Pressure testing of piping and ductwork systems.
3. Testing of boilers and pressure vessels.
4. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper balancing, refer to the respective system Sections for materials and installation requirements.
5. Piping and ductwork system leakage tests.
6. Electrical hook-up and wiring of equipment and devices to be tested, adjusted, and balanced.

1.02 PERFORMANCE REQUIREMENTS

A. Procedures, measurements, instruments and test reports for testing, adjusting and balancing work shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE)

Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

National Environmental Balancing Bureau (NEBB)

Associated Air Balance Council (AABC)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. The air delivery or intake of each diffuser, grille and register shall be as designed or within five percent of the air flow rates shown on the Contract Drawings.

C. The fan air flow rate and static pressure rise across the fan shall be within 10 percent above the design value at design speed.

1.03 JOB CONDITIONS

A. The Contractor shall have the testing and balancing specialist review his work with the respective manufacturers of the equipment and devices involved, and shall coordinate and schedule all Work.

B. The Contractor shall furnish and install balancing dampers, pressure taps, gauges, valves, and other components as required for a properly balanced system, whether or not specified herein or shown on the Contract Drawings, all at no additional cost to the Authority. Adjustment or replacement of parts recommended by the testing and balancing specialist shall be made in strict accordance with the respective equipment manufacturer's recommendations.

C. The Contractor shall have the control manufacturer's representative set the adjustment of the automatically operated dampers and control valves to operate as required.

1.04 QUALITY ASSURANCE

A. Entities performing the Work of this Section shall have had experience similar to that required for this Project for not less than three years.

B. Entities performing the Work of this Section shall be certified by NEBB or AABC and shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 PATCHING MATERIALS

Unless otherwise shown on the Contract Drawings, use same products as originally installed for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

PART 3. EXECUTION

3.01 EXAMINATION

A. Obtain design drawings and specifications (or as-built drawings and specifications, if such exist), and become thoroughly acquainted with design intent.

B. Obtain copies of approved shop drawings of all air handling and hydronic equipment, air outlets (supply, return and exhaust), manual valves, automatic valves and the temperature control diagrams, including intended sequence of operation.

C. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned, and is operable. Do not proceed with testing, adjusting and balancing until unsatisfactory conditions have been corrected in a manner approved by the testing and balancing specialist.

D. Examine the air systems to see that they are free from obstructions. Determine that all dampers and registers are open, moving equipment is lubricated, clean filters are installed, and automatic controls are functioning; and perform other inspection and maintenance activities necessary for proper operation of the systems.

E. Examine the hydronic systems to see that they are free from abnormal obstructions, and that all piping, valves and equipment have been properly made fully operational. Determine that all equipment and control systems are performing correctly by functional testing.

3.02 TESTING, BALANCING, AND ADJUSTING

A. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of test procedure.

B. Testing and balancing specialist shall perform tests and compile test data for all air systems and hydronic systems.

C. Data shall include a schematic diagram locating the air inlets, outlets, fans, equipment, dampers and regulating devices for air systems, and a schematic diagram for location of balancing valves, flow indicators, equipment, and devices for hydronic systems.

D. All instruments used shall be provided by the entity performing the Work of this Section, and shall be accurately calibrated and maintained in good working order.

E. Air Systems

The testing, adjusting and balancing of air systems shall be in accordance with the detailed procedures outlined in the referenced standards; and shall include but not be limited to the following:

1. Test, record and adjust fan rpm to design requirements.
2. Test and record motor full load amperes.
3. Make pitot tube traverse of main supply ducts and obtain design flow rate at fans.
4. Test and record system static pressure, velocity pressure and total pressure.
5. Test and adjust system for design supply, transfer and return air flow rate.

6. Test and adjust system for minimum and maximum design flow rates of outside air.

7. Test and record return air temperatures.

8. Test and record entering mixed air temperatures.

9. Test and record coil and fan leaving air temperatures.

10. Adjust all main supply, return, relief, and exhaust air ducts to proper design flow rate.

11. Adjust all zones to proper design flow rate for supply, return, transfer, relief and exhaust air.

12. Test and adjust each diffuser, grille and register.

13. Each grille, diffuser and register shall be identified as to location and area on the schematic diagram.

14. Size, type and manufacturer of diffusers, grilles and registers and all tested equipment shall be identified and listed in the final report. Manufacturer's data on all equipment shall be used to make required calculations for testing, adjusting and balancing. Readings and tests of diffusers, grilles and registers shall include design required velocity and test resultant velocity, required flow rate and test resultant flow rate after adjustments.

15. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

16. Dampers shall be permanently marked after air balance is complete so that they can be restored to their correct position, if disturbed later.

17. Openings in ductwork for pitot tube insertion shall be sealed with snap-in plugs after air balance is complete.

F. Hydronic Systems

The testing, adjusting and balancing of hydronic systems shall be in accordance with the detailed procedures outlined in the referenced standards; and shall include but not be limited to the following:

1. Preliminary procedure prior to balancing:

   a. Examine water in systems and determine if water has been treated and cleaned.

   b. Check expansion tank to determine that it is not air bound and the system is completely full of water.

   c. Purge all air vents at high points of water systems, check automatic air vents and determine if they are operating properly.

   d. Coordinate with control manufacturer for required cooling and heating temperature controls and corresponding, automatic valve operation settings.

   e. Open all normally open valves to full open position. Set automatic valves to full coil flow.

   f. Complete air balance shall have been accomplished before final water balance begins.

   g. Check water pumps for pump rotation and for proper flow rate delivery against manufacturer's pump curves.

h. Set all balancing valves for required flow delivery at mains and branch mains to cooling and heating elements.

i. Upon completion of flow readings and adjustments of balancing valves, mark all settings and record data, so that they can be restored to their correct "balanced" position, if disturbed later.

2. Final balancing shall include the following:

a. After required cooling and heating temperature controls and automatic valve operation settings are made, recheck pump flow requirements and readjust system as required.

b. Record pressure drop through coil at set flow rate of coil for full cooling and on full heating. Set pressure drop across bypass valve to match coil pressure drop.

c. Record and check the following items at each cooling and heating element:

(1) Inlet water temperatures and static pressure at connections.

(2) Leaving water temperatures and the pressure drop of each coil.

(3) Flow rate through coil with control valve stroked manually wide open.

d. Record operating suction and discharge pressures of each pump and final total dynamic head and rated amperage versus actual amperage of pump motors.

e. Record entering and leaving water temperatures and flow through all equipment and devices.

f. Check and record all flow rates at all locations in the piping system with flow meters.

G. Upon completion of air and hydronic systems testing, patch insulation, ductwork and housings, using materials identical to those removed (refer to 2.01).

H. Final testing, adjusting and balancing shall be performed during summer season for air conditioning systems and during winter season for heating systems, including operation when outside conditions are within 5 degrees F wet bulb temperature of maximum summer design condition, and within 10 degrees F dry bulb temperature of minimum winter design condition.

I. Retest, adjust, and balance systems subsequent to system modifications. Resubmit test results.

END OF SECTION

SECTION 15992

TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Qualifications

15992K01 a. Certification that the testing, adjusting and balancing entity meets the requirements of 1.04 and all other specified requirements.
b. Prior to performing the work, submit sample blank forms of the test reports that will be used, indicating all data and parameters to be included.

Inspection Reports

15992O01 Draft Reports: Submit certified test reports, signed by the authorized representative of the testing and balancing specialist. The reports shall be certified proof that the systems have been tested, adjusted and balanced in accordance with 1.02 A (NEBB or AABC); are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.
Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft report may be handwritten, but must be complete, factual, accurate and legible. Organize and format draft reports as described herein below. Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.

Report Format: Report forms shall be the standard forms as specified in 1.02 A for each respective item and system to be tested, adjusted and balanced. Include schematic system diagrams. Enclose the report contents in a 3-ring binder. Divide the contents into the below listed divisions, separating them by divider tabs with titles descriptive of the contents:

(1) General Information and Summary.
(2) Air Systems.
(3) Hydronic Systems.

15992O02 Final Reports: Submit certified test reports, signed by the authorized representative of the testing and balancing specialist. The reports shall be certified proof that the systems have been tested, adjusted and balanced in accordance with the selected reference standards (NEBB or AABC); are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at completion of the testing, adjusting and balancing procedures; and are an accurate record of all final

quantities measured, to establish normal operating values of the systems.
Upon verification and approval of draft reports, prepare final reports, typewritten, organized and formatted as described herein below. Submit two complete sets of final reports.

Report Format: Report forms shall be the standard forms as specified in 1.02 A for each respective item and system to be tested, adjusted and balanced. Include schematic system diagrams. Enclose the report contents in a 3-ring binder. Divide the contents into the below listed divisions, separating them by divider tabs with titles descriptive of the contents:

a. General Information and Summary.
b. Air Systems.
c. Hydronic Systems.

Report Contents: Provide the following minimum information, forms and data:

a. General Information and Summary: the inside cover sheet shall identify the testing, adjusting and balancing Agency, Contractor, Owner, Engineer and Project. Include addresses, contact names and telephone numbers. Include a certification sheet containing the seal and name, address, telephone number and signature of the Agency's responsible certified Test and Balance Engineer. Include in this division a listing of the instrumentation used for the procedures, along with the proof of calibrations.

b. The remainder of the reports shall contain the appropriate forms containing, as a minimum, the information indicated on the standard report forms prepared by AABC and NEBB, for each item of equipment and system. Prepare a schematic diagram for each item of equipment and system, to accompany each respective report form.

Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in 1.02 A within a period not exceeding six months prior to conducting the test procedures.

END OF APPENDIX "A"

DIVISION 16

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

PART 1. GENERAL

1.01 SUMMARY

A. Unless otherwise shown on the Contract Drawings, or unless otherwise specified in other Sections of these Specifications, the general requirements specified in this Section are applicable to all electrical work of this Contract. Additional requirements applicable to individual Sections of these Specifications are specified in those Sections, or are shown on the Contract Drawings.

1.02 REFERENCES

A. American National Standards Institute (ANSI)

1. Z535.4 – Product Safety Signs and Labels

B. Institute of Electrical and Electronics Engineers (IEEE)

1. C2 - National Electrical Safety Code (NESC)

C. ASTM International (ASTM)

1. D178 - Standard Specification for Rubber Insulation Matting

D. National Fire Protection Association (NFPA)

1. 70 - National Electrical Code
2. 70E – Standard for Electrical Safety in the Workplace

E. Occupational Safety and Health Administration (OSHA)

F. International Code Council (ICC)

1. IBC – International Building Code
2. IECC – International Energy Conservation Code
3. IEBC – International Existing Building Code
4. IFC – International Fire Code

1.03 QUALITY ASSURANCE

A. Any entity performing Work shall have had experience on at least two projects of similar size and scope as this project.

B. All workers performing Work shall be skilled workers of the trade involved. Where specialty work, such as splicing or welding are required, submit proof of training, experience and work history for each worker, for review by the Engineer. Only approved workers shall perform specialty work.

C. All electrical work shall be performed under the supervision of an electrical contractor, licensed in the State in which the work is to be performed. Submit a copy of the qualifying license for review by the Engineer.

D. All calculations required by this and other various Sections of these Specifications, or as shown on the Contract Drawings, shall be certified and sealed by a Professional Engineer licensed in the State in which the work is to be performed, and shall be submitted to the Engineer for review.

E. Various Sections of these Specifications contain the requirement for the specific material or equipment to be furnished with an experience statement "satisfactorily used for purposes similar to those intended herein" or words of similar intent and a statement that specifies the required experience time. These statements shall mean that the manufacturer of the material or equipment being furnished for the work specified in this Contract shall have manufactured similar material or equipment to that specified, for at least the time specified.

F. In various Sections of this Division, there is a statement that refers to the length of required experience that must be satisfied.

G. Polyvinyl Chloride (PVC): PVC conduits, PVC-Insulated power wiring, or items containing PVC, except PVC-insulated wiring for communication systems, remote control, signaling, and power-limited circuits, shall not be installed in any indoor area. PVC-insulated wiring for communication systems, remote control, signaling, and power-limited circuits shall be furnished and installed in accordance with NFPA 70.

H. Asbestos

1. Asbestos or items containing asbestos shall not be furnished or installed.

I. Conformance Labels

1. All electrical materials and equipment for which there is a nationally recognized standard shall bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc., Factory Mutual, Edison testing Laboratory – Swedish Electric Equipment Control Office (ETL SEMKO), or approved equal. Where the phrase "where there are established UL standards shall bear the UL label," or words of similar intent appear in other Sections, the instructions for the conformance label above shall apply.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

1.05 CODES AND STANDARDS

A. The electrical installation shall conform to all requirements of IEEE C2, NFPA 70, and the codes and standards specified in other Sections, all local codes and the requirements of OSHA, which would be applicable if the Authority were a private corporation.

B. Standards of technical organizations and regulatory agencies are referenced in other Sections, and unless stricter requirements are indicated, materials and equipment so specified shall be manufactured, tested and installed to conform, as a minimum, to the requirements of such reference standards and publications.

C. In case of conflict between provisions of codes, laws, and ordinances, the more stringent requirement shall apply.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver material in manufacturers' original unopened protective packaging.

B. Store materials in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such covers as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

PART 2. PRODUCTS

2.01 MATERIAL AND EQUIPMENT TO BE FURNISHED

A. Equipment and materials furnished shall be new and unused prior to this installation. Equipment shall be first grade commercial quality and shall be essentially the standard cataloged products of a manufacturer regularly engaged in the manufacture of the products. Only those items specifically shown on the Contract Drawings as existing relocated or Authority furnished shall be reused in this installation. Rebuilt or remanufactured equipment shall not be permitted.

2.02 IDENTIFICATION

A. All parts of equipment, such as switchboards, panel boards, safety switches, motor starters, circuit breakers, time clocks, contactors and similar items shall be identified by name, function or control with laminated-plastic nameplates consisting of two black sheets with one white sheet bonded to and between the two outer sheets and having letters machine engraved in the face sheet to the depth of the white plastic. Nameplates shall not be smaller than 1 inch by 3 inches with characters not less than 1/4 inch in height. Where letter sizes are not specified, use 1-inch high letters for panel boards, switchboards and motor control centers and ¼-inch high elsewhere. Nomenclature shall be according to a schedule approved by the Engineer.

B. All device plates other than lighting switch plates, telephone and 120 volt, single phase, 15 or 20 ampere receptacles, shall have black or white (as directed) silk-screened lettering Helvetica Medium type face (or other type face as directed by the Engineer) designating:

1. System
2. Voltage (where applicable)
3. Number of phases (where applicable)
4. Current rating (where applicable)
5. Frequency (where applicable)

C. Before placing orders for nameplates or silk-screened device plates, submit a typewritten list to the Engineer for review.

D. The outside of the covers of all junction or pull boxes located above hung ceilings and the inside of the covers of all junction or pull boxes exposed shall be labeled with an indelible marker indicating the operating voltage and the system contained therein.

E. All device plates of receptacles connected to a standby or emergency power distribution system shall be labeled with an orange plastic nameplate, engraved with the panel board and circuit number to which the receptacle is connected. Nameplate character engraved shall be not less than 6 mm in height.

F. Unless otherwise shown on the Contract Drawings, all panel boards, switchboards, switchgear, circuit breakers, switches and transformers connected to a standby or emergency power distribution system shall be finished Federal Safety Orange in color.

2.03 RUBBER MATTING

A. Provide continuous insulated rubber matting not less than 1 m wide and not less than 6 mm thick in one piece in front of:

1. Substation Transformers
2. Switchgear
3. Switchboards
4. Motor control centers
5. Panel boards
6. On each side and end of a standby or emergency generator set
7. Other locations as shown on the Contract Drawings

B. Matting shall conform to ASTM D 178, Type 2.

PART 3. EXECUTION

3.01 GENERAL

A. Work of this Division shall include all labor, material and apparatus necessary for the completion of all electrical work as shown on the Contract Drawings and as hereinafter specified, left ready for satisfactory operation.

B. Coordinate with Authority operations and construction by other trades.

1. Coordinate with the Work of all trades as necessary to facilitate timely completion, avoid unnecessary cutting and patching and to ensure proper installation and operation of all equipment.
2. Coordinate all components and aspects of the work, in order to minimize power shutdowns to the power distribution systems. Should any part of the Work require an "off-hours" shutdown in excess of eight hours, supply temporary services or feeders as required maintaining operation of the existing systems and equipment.
3. Furnish to appropriate trades, shop drawings, catalog cuts and instructions necessary for construction of concrete bases, concrete encasement, anchor bolts, and other construction required to accommodate installations under other Sections.
4. Obtain all wiring diagrams and other instructions required for proper electrical connection of equipment installed or furnished under other Divisions of these Specifications and coordinate the installation, wiring and connections for equipment furnished under this Division, or other various Divisions.

C. The arrangement of electrical equipment and conduit runs as shown on the Contract Drawings and described in the Specifications is schematic. Locate and install electrical work in coordination with other trades so that all electrical equipment and material installed with working clearances in accordance with NFPA 70. Route all conduits to avoid interferences with existing conduits, mechanical systems, other equipment installations and work performed by other trades.

D. The location of equipment and motors shown on the Contract Drawings shall be subject to minor revisions due to field conditions or coordination with other trades without any increase in Contractor's compensation. Prior to roughing-in, verify the exact location of all electrical connections to equipment and motors from reviewed shop drawings and field verification.

E. Maintain records of all inspections, testing, overload and over-current settings throughout the construction and any corrective actions taken, and submit records to the Engineer for review.

F. All electrical work shall be subject to inspection by the Engineer. Correct any deficient work, as required for the approval of the Engineer.

G. Any equipment, materials, wiring or labor that are a necessary part of the electrical work and to its proper performance, although not specifically mentioned herein or shown on the Contract Drawings, shall be furnished and installed as if called for in detail without additional cost to the Authority.

3.02 REMOVALS, RELOCATIONS, RECONNECTIONS, RESTORATIONS

A. Relocate existing equipment and materials as shown on the Contract Drawings.

B. Unless otherwise shown on the Contract Drawings, existing equipment and materials that are to be removed and not required to be relocated under this Contract, shall become the property of the Contractor and shall be removed from the property of the Authority, and shall be properly disposed of. Disposal of equipment and materials shall comply with all local, state and Federal laws and regulations as if the Authority was a private corporation.

C. Unless specifically shown on the Contract Drawings, do not use salvaged equipment and materials in the installation.

D. If existing electrical feeders, wiring, conduit, lighting fixtures or equipment interferes with the installation of new construction of any trade, the existing electrical feeder, reroute wiring and conduit or the relocated equipment in a manner approved by the Engineer to permit installation of the new construction. Where existing circuits or devices, or portions of the existing wiring system are to remain in service, but are interrupted by the construction, continue the existing wiring to maintain the remainder of the wiring system in operation.

E. Notify the Engineer immediately of any damage caused by the Contractor to existing wiring, services or feeders, which are to remain in service. Repair the damage in a workmanlike manner to restore to service, at no cost to the Authority.

F. Before shutdown or discontinuation of service on any circuit, system or feeder, coordinate such activities with the Engineer in order to minimize shutdown periods. Provide a minimum of two weeks notice in writing to the Engineer before performing any shutdowns. The minimum period may be reduced with the express written permission of the Engineer.

3.03 LOCATION OF EQUIPMENT

A. Unless otherwise shown on the Contract Drawings, the location of outlets or devices, from finished floor to center of plate or device, shall be as follows:

1. Lighting switches: 48 inches
2. Thermal switches: 48 inches
3. Receptacles: 16 inches
4. Telephone outlets: 16 inches
5. Fire alarm stations: 48 inches
6. Fire alarm horn/light signals: 7 feet, 6 inches
7. Clocks: 7 feet, 8 inches

B. Unless otherwise shown on the Contract Drawings, the location of equipment, from finished floor to top of enclosures shall not exceed 6 feet, 6 inches, and shall not protrude more than 4 inches if higher than 27 inches.

1. In exposed or public locations, panel boards and cabinets shall generally be flush mounted and all covers shall be identical in layout and size, and shall be installed to maintain a level and straight top and bottom alignment.
2. In concealed locations, or in closets or electrical or mechanical rooms, or non-public locations, panel boards and cabinets shall generally be surface mounted and shall be installed to maintain a level and straight top alignment.

3.04 DISSIMILAR METALS

A. Dissimilar metals shall mean those metals, which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

B. Transitions in raceways, from one metal to a dissimilar metal shall only be made at boxes or other enclosures, except where shown on the Contract Drawings.

3.05 NAMEPLATES

A. Secure nameplates on equipment or walls with stainless steel or brass screws.

3.06 RUBBER MATS

A. Install rubber mats in front of each panel board, switchboard, motor control center, switchgear and substation transformers, and along each side and the end of each generator set, or as shown on the Contract Drawings.

B. Rubber mats when installed shall lay flat without curling.

3.07 CUTTING AND PATCHING

A. Perform all cutting and patching of existing construction required for installation of all materials and equipment as specified in this Division.

B. Perform all patching to match existing adjacent construction to the satisfaction of the Engineer and using the best possible workmanship of the various trades involved.

3.08 FINAL FIELD TESTS

A. The entire electrical installation shall be inspected prior to final acceptance testing, thoroughly cleaned, and damaged finishes touched up after final completion and prior to final acceptance testing being performed. Not less than 30 days prior to the testing, furnish a test plan to the Engineer for review, outlining all aspects of the testing, including tests to be performed and the expected results.

B. Perform the following field test in the presence of the Engineer to demonstrate the reliability of the electrical installation. Give the Engineer a minimum of one week's advanced notice of such tests.

1. Operate all electrical systems and equipment for a period of 24 hours unless in the opinion of the Engineer a different test period is required, to prove the operation and performance of a system and its equipment.
2. Should the foregoing test reveal any defects, promptly correct such defects and re-run the tests until the entire installation conforms to the requirements of these Specifications and the Contract Drawings.

C. Tests requiring certified reports and those requiring factory or field inspection shall be conducted and reported to the Engineer in conformance with standards herein specified.

D. In addition to the tests outlined above, after completion of the electrical system and prior to occupancy:

1. The following equipment and devices, as a minimum, shall be thermographically inspected utilizing a Hughes Aircraft Probeye infrared detector, or approved equal, with videotaping attachment.
   a. High voltage cable splices and connections
   b. Switchboard
   c. Transformer
   d. Switchgear
   e. Panel boards
   f. Motor Control Centers
   g. Automatic transfer switch and emergency power system connections
   h. Chiller motor and starter connections
   i. All 600 volt (nominal) cable connections rated 100 amperes (No. 3 AWG) or greater
   j. Other equipment as shown on the Contract Drawings
2. The inspection shall be made by an independent inspection company such as Infrared Services, Inc, Montville, N.J, General Electric Apparatus Service Division, or approved equal.
3. The inspection shall be made with all equipment, motors, lighting fixtures, and miscellaneous loads operating and with all equipment covers removed.
4. Inspection reports complete with color photographs of the infrared scan and control photographs indicating the ambient temperature and any hot spots of each item inspected, shall be submitted to the Engineer for approval.
5. Any equipment, connections or devices indicated to be operating improperly performing equipment shall be replaced or repaired by the Contractor at no cost to the Authority. The cost of inspection and necessary repairs shall be included in the Contract.

6. Demonstrate to the Engineer equipment or systems installed or modified in this Contract.

7. After completion of all testing, and prior to placing equipment or systems in operation, demonstrate the features and operation of the equipment or systems to the Engineer and all other staff as designed by the Engineer, so that operational and maintenance personnel are familiarized with the equipment and systems, as follows:

   a. Switchboards and panel boards

   b. Transformer

   c. Switchgear

   d. Motor control centers

   e. Fire alarm and smoke detection systems

   f. Automatic transfer switches

   g. Standby/Emergency generator sets

   h. Other equipment as shown on the Contract Drawings

8. Provide the necessary accessories, test equipment, and personnel, for each demonstration.

9. Coordinate with the Engineer the number of training documentation required for each demonstration. At a minimum one document, copy shall be provided to each attendee unless otherwise directed by the Engineer. The cost of the demonstration and documentation package provided to the Authority shall be included in the contract.

10. Training documents: are defined as any or all of the following, maintenance and operations manuals, user manuals, shop drawings, equipment schematics, troubleshooting manuals, and other supplemental documentation for the demonstration. Only manuals approved by the Engineer shall be distributed at a demonstration any required manuals for distribution shall be submitted to the Engineer for approval.

11. Coordinate all arrangements for the demonstrations through the Engineer.

12. Upon the completion of each demonstration or instructional session, obtain "sign-off" from the Engineer. The "sign-off" shall state that the demonstration or instructions for use were provided, that they were complete and were given to the designated personnel.

3.09 PROTECTION AND SAFETY

A. During installation, energizing and testing of any equipment that may pose arc flash hazard, the Contractor shall establish and follow Electrical Safety and Arc Flash protection procedures in accordance with NFPA 70E and OSHA, as applicable.

B. Prepare and submit for approval recommended procedures for workplace electrical safety and arc flash protection of any personnel maintaining or working around equipment subject to arc flash, in accordance with NFPA 70E, OSHA and the equipment manufacturer's recommendations. Include:

   1. Recommended arc flash protection boundary area around equipment.

   2. Recommended safety related work practices and procedures for operating equipment.

   3. Recommended safety related work practices and procedures for maintaining equipment.

C. Provide Arc Flash hazard warning labels on all equipment that may pose arc flash hazard. Provide appropriate Arc Flash Hazard signage in all rooms containing such equipment. Labels and signage shall be in accordance with ANSI Z535.4, NFPA 70, NFPA 70E and OSHA requirements.

END OF SECTION

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

APPENDIX "A"

SUBMITTALS

A. Submit not less than the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of DIVISION 1 - GENERAL PROVISIONS:

1. Catalog Cuts
   - a. Conduit and fittings
   - b. Wire and cable
   - c. Wiring devices
   - d. Multi-outlet assemblies
   - e. "Standard" outlet and junction boxes
   - f. Medium voltage cable, splicing and termination kits
   - g. Lightning arresters
   - h. Capacitors
   - i. Panel boards and cabinets
   - j. General purpose transformers
   - k. Circuit breakers
   - l. Lighting fixtures
   - m. Pulling devices and end seals
   - n. Special pull and junction boxes
   - o. Supporting devices
2. Shop Drawings
   - a. Substation and high-voltage transformers
   - b. Switchgear
   - c. Switchboards
   - d. Motor control centers
   - e. Emergency lighting battery systems

B. Submit calculations where required by the Specifications or the Contract Drawings.

C. Submit certifications, training, experience and work history for splicers and welders.

D. Submit working drawings for the installation sequence of medium voltage cables, and other systems where shown on the Contract Drawings, including the reel designations for each leg of the installation. Drawings shall include the calculations for pulling tensions and sidewall pressure of all cable pulls, including identification of manhole locations with splices and manholes, which shall be "pulled through" without splicing. Calculations must be certified and sealed by a Professional Engineer licensed in the State in which the work is performed.

E. Submit various details of field required and assembled systems not already detailed in the Contract Documents.

F. Submit a final copy of the records and certified test reports for all tests, to the Engineer for review, for not less than the following:

1. Ground fault circuit breaker and receptacle testing
2. Setting of all adjustable over-current devices
3. Setting or size of all overload elements installed, indicating the following:
   a. Motor designation
   b. Nameplate horsepower, full load current, voltage and phases
   c. Operating current and voltage
   d. Overload element size or setting.
4. Emergency power distribution equipment and system test results.

G. Submit one (1) set of prints of Contract Drawings neatly marked up to show any deviations in the actual installation from the conditions shown on the Contract Drawings as issued, and showing the exact location of all equipment and conduit runs, as actually installed.

H. Submit nameplate designations

1. Panel boards
2. Switchgear
3. Transformers
4. Motor Control Centers (MCCs)
5. Disconnect Switches
6. Other Electrical Equipment as specified on Contract Drawings.

I. Submit operation and maintenance manuals, where required by the Specifications or the Contract Drawings.

J. Submit protection and Safety Submittal Requirements:

1. Prepare and submit procedures for workplace electrical safety and arc flash protection in accordance with 3.09 of this Specification.
2. Catalog cuts or drawings for arc flash hazard warning labels and signage.
3. Identification of equipment requiring arc flash labels and locations of arc hazard warning signage.

K. Submit Record Documents

1. One set of Shop Drawings revised, completed and brought up to date showing the permanent construction as actually made, in accordance with "Shop Drawings, Catalog Cuts and Samples" of Division 1, and showing the exact location of all equipment and conduit runs, as actually installed.

L. Submit Site Inspection Reports

A final copy of the records and certified test reports for all tests to the Engineer for review, for not less than the following:

1. Primary Cable and terminators insulation testing
2. Insulation testing of 600V (nominal) cables rated 100 amperes (#3 AWG) and above.

3. Ground resistance test of each service ground
4. Ground fault circuit breaker and receptacle testing
5. Setting of all adjustable over current devices
6. Setting or size of all overload elements installed, indicating the following:
7. Moto Designations
8. Nameplate horsepower, full load current, lock rotor current, voltage and phases.
9. Operating current and voltage
10. Overload element size or setting.
11. Emergency power distribution equipment and system test results

END OF APPENDIX "A"

DIVISION 16

SECTION 16110

RACEWAYS

PART 1. GENERAL

1.01 SUMMARY

A. This section specifies requirements for raceways.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Not applicable

1.03 RELATED SECTIONS

A. Section 16190 – Supporting Devices

1.04 REFERENCES

A. American National Standards Institute (ANSI)
1. C80.1 - Specification for Rigid Steel Conduit, Zinc Coated
2. C80.3 - Electrical Metallic Tubing - Zinc Coated
3. C80.5 - Rigid Aluminum Conduit
4. C80.6 - Intermediate Metal Conduit - Zinc Coated

B. National Electrical Manufacturers Association (NEMA)
1. FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
2. RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
3. TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
4. TC6&8 - PBC Plastic Utilities Duct for Underground Installations
5. TC14 - Thermosetting Resin Conduit and Fittings

C. ASTM International (ASTM)
1. E800 Standard Guide for Measurements of Gases Present or Generated During Fires

D. National Fire Protection Association (NFPA)
1. 70 - National Electrical Code

E. Underwriters Laboratories Inc. (UL)
1. 1 - Flexible Metal Conduit
2. 5 - Surface Metal Raceways and Fittings
3. 6 - Rigid Metal Conduit
4. 209 - Cellular Metal Floor Raceways and Fittings
5. 360 - Liquid-Tight Flexible Steel Conduit

6. 514B - Fittings for Conduit and Outlet Boxes
7. 651 - Schedule 40 and 80 Rigid PVC Conduit
8. 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit
9. 797 - Electrical Metallic Tubing
10. 870 - Wireways, Auxiliary Gutters, and Associated Fittings
11. 884 - Underfloor Raceways and Fittings
12. 1242 - Intermediate Metal Conduit
13. 1479 - Standard for Fire Tests of Through-Penetration Firestops
14. 1684 –Reinforced Thermosetting Resin Conduit

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Not Applicable

1.06 QUALITY ASSURANCE

A. Deliver material in manufacturer's original, unopened, protective packaging. Protective caps shall be removed only upon installation of conduit.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Locations, types and sizes of raceways are shown on the Contract Drawings.
2. Minimum size of conduit shall be 3/4 inch.
3. Conduit shall be supplied in a minimum of 10-foot lengths and accordance with UL.

B. Rigid Metal Conduit

1. RGS - Rigid galvanized steel conduit (Heavy-wall) hot dipped galvanized inside and out, with hot dipped galvanized threads, conduit shall conform to UL 6 and ANSI C80.1.
2. IMC - Intermediate metal conduit, galvanized steel (medium-wall) conduit, threads shall be galvanized and shall conform to ANSI/UL 1242 and ANSI C80.6.
3. ALC - Aluminum conduit shall conform to UL 6 and ANSI C80.5.
4. All preformed elbows shall be the same in construction to and of a type designed for use with the appropriate conduit and shall conform to UL 6.
5. All fittings shall be threaded and shall conform to NEMA FB1.
6. If threads are cut after the zinc coating has been applied, the threads shall be treated with protective coating of zinc equivalent to hot-dipped process.

C. Electrical Metallic Tubing

1. EMT - Electrical metallic tubing (thin-wall) shall be galvanized steel and shall conform to ANSI/UL 797 and ANSI C80.3
2. All fittings shall be indenter or compression type made of malleable or pressed steel and shall conform to ANSI/NEMA FB1.

D. Polyvinyl Chloride Coated Rigid Galvanized Steel Conduit

1. RGS/PVC shall be PVC coated Rigid Galvanized Steel conduit (heavy wall). All conduit shall be hot dipped galvanized steel inside and out, with hot dipped galvanized threads. Conduit shall be certified as conforming to UL-6 and ANSI C80 prior to application of the PVC coating. All PVC coated conduit boxes, bodies and fittings shall be hot dipped rigid galvanized steel, certified as conforming to UL-514B prior to application of the PVC coating.
2. The interior of all conduits, boxes, bodies and fittings shall have a uniformly applied urethane coating, a minimum of 2 mils thick. The exterior of all conduits, boxes, bodies and fittings shall have a 40 mils thick PVC coating, smoothly and uniformly applied by dipping in liquid plastisol. All conduits shall have a series of longitudinal ribs, 40 mils in thickness, to protect the PVC coating from damage during installation.
3. All PVC coating materials shall be certified as conforming to NEMA RN-1 and UL-6, after application of the PVC coating. The PVC shall be certified as providing the primary corrosion protection, in accordance with UL-6. All materials shall bear the UL label accordingly.
4. The exterior PVC coating and interior urethane coating applied to all conduits shall have sufficient flexibility to permit field bending without cracking, flaking, or chipping of any of the coatings.
5. All PVC coating shall be UV resistant.

E. Cellular Metal Floor Raceway

1. Cellular Metal Floor Raceway and Fittings shall conform to NFPA 70 and ANSI/UL 209.

F. Flexible Metal Conduit

1. FSC - Flexible steel (galvanized) conduit shall conform to ANSI/UL 1.
2. LSC - Liquid-tight flexible metal conduit shall conform to ANSI/UL 360.
3. Fittings shall be of a type designed for use with the respective conduit and shall conform to ANSI/UL 514B.

G. Surface Metal Raceways

1. Surface raceways shall conform to ANSI/UL 5.
2. Surface metal raceways shall come complete with all necessary accessories for installation.

H. Underfloor Raceways

1. Duct, fittings, and accessories shall be suitable for encasement in concrete and shall conform to NFPA 70 and ANSI/UL 884.
2. Underfloor raceways shall come complete with all necessary accessories for installation.

I. Rigid Nonmetallic Conduit

1. PVC Type 40 Standard Wall polyvinyl chloride (PVC) conduit shall conform to ANSI/UL 651 and NEMA TC-3.
2. PVC Type 80 Heavy wall polyvinyl chloride (PVC) conduit shall conform to ANSI/UL 651.
3. PVC Type "A" Light wall polyvinyl chloride (PVC) conduit shall conform to NSI/UL 651A
4. PVC Type EB Light wall polyvinyl chloride (PVC) conduit shall conform to ANSI/UL 651A and NEMA TC-8.
5. PVC Type DB Light wall polyvinyl chloride (PVC) conduit shall conform to ANSI/UL 651A and NEMA TC-8.
6. HDPE Type 40 Standard wall High-Density Polyethylene (HDPE) Conduit shall conform to ANSI/UL 651A and NEMA TC-6.

J. Fiberglass Reinforced Epoxy Conduit (FRE)

1. Fiberglass Reinforced Epoxy conduit (FRE) shall conform to ANSI/UL 870. All FRE conduit installed above or below ground shall be UL listed as an approved raceway for above or below ground installations respectively. FRE shall be one of the following, as indicated on the Contract Drawings:
   a. Heavy Wall Fiberglass Conduit (FRE -S): FRE -S conduit wall thickness shall be not less than 70 mils for conduits less than 4 inch trade size, not less than 90 mils for conduits 4 inch trade size and not less than 110 mils for larger than 4 inch trade size. Type FRE -S shall only be used where direct buried or encased in concrete and shall be UL listed for the intended use.
   b. Extra Heavy Wall High Impact/Bullet Resistant Fiberglass Conduit (FRE -XW): FGS-XW shall have a wall thickness not les than 250 mils for all trade sizes. Type FRE -XW shall be used for exposed exterior installations, next to active roadways, where installed on or below bridges and elevated roadway or where subject to physical damage. All FRE -XW shall be UL listed for above ground installation.
2. FRE Conduit installed in exterior locations, inside tunnels or in railroad/subway, areas shall not contain any compounds or materials that release halogens when burned. Conduit manufacturer shall submit certification that the conduit and fittings are zero-halogen. Zero-halogen shall be defined as not exceeding the following gas toxicity levels, as tested in accordance with ASTM E800:

	Gases	Values (max P.P.M.)
1.	Hydrogen Chloride	0
2.	Hydrogen Bromide	0
3.	Hydrogen Cyanide	<1
4.	Hydrogen Sulfide	0
5.	Vinyl Chloride	<10
6.	Ammonia	0
7.	Aldehides as HCHO	<10
8.	Oxides of Nitrogen	<50
9.	Carbon Monoxide	<250
10.	Carbon Dioxide	<12,000

K. Cellular Metal Floor Raceway Cellular Metal Floor Raceway and Fittings shall conform to NFPA 70 and UL 209.

L. Fire Stops, Through Penetrations of Conduits

1. Where raceways penetrate wall or floor, fire stops with a fire rating equal or greater than the rating of the penetrated wall or floor shall be provided.
2. All fire stops shall conform to the UL 1479.

M. Wireways

1. Wireways shall be seamless galvanized steel construction, cover to be locked with captive screws and shall conform to ANSI/UL 870.
2. Wireways shall come complete with all necessary accessories for installation.

N. Fastening Devices

1. Provide inserts, clamps, bolts and washers, or any other type of fastening devices conforming to the requirements of Section 16190 required to secure conduits to walls or above hung ceilings. Unless otherwise shown on the Contract Drawings, all fasteners shall be hot dipped galvanized and of sizes and types recommended by the equipment manufacturer.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. All conduit bends shall be accomplished with a trade approved bending tool and in accordance with the manufacturer's recommendations and NFPA 70.
2. Ream conduit ends free from burrs prior to installation, and draw joints up tight.
3. Make transitions in conduit from one metal to a dissimilar metal only at boxes or other enclosures, unless otherwise shown on the Contract Drawings.
4. Install concealed conduits or tubing in as direct a line as possible.
5. Install exposed raceways, located above hung or accessible ceilings, parallel with or at right angles to the lines of buildings and as close to the ceiling as possible, unless otherwise shown on the Contract Drawings.
6. Install expansion fittings in all conduits that cross expansion joints, where conduits attach to independent structures, or where exposed to large temperature changes.
7. Securely fasten threaded conduits entering enclosures, other than threaded cast boxes, by means of two lock-nuts, one on each side of the enclosure. Terminate the conduits in insulated bushings.
8. Cap all free ends of empty conduit to prevent water entrance.
9. Conduit through roofs and external walls of buildings, manholes and other structures shall be watertight. Contractor shall submit detailed shop drawings for the Engineer's approval.
10. Where portions of an interior raceway system are exposed to widely different temperatures, make provisions to prevent circulation of air from a warmer to a colder section through the raceways.
11. Apply zinc rich paint to all exposed threads after joints have been made up clean and tight.
12. Support all conduits as required in these Specifications under Section 16190.
13. All conduit runs shall leave or enter structures perpendicularly.

14. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

B. Rigid Metal Conduit

1. RGS shall be used where Fire Alarm Systems are installed.
2. RGS/PVC shall not be used indoors.
3. IMC may not be used in wet locations, or high corrosive area, otherwise NFPA 70 Article 342 fully applies.

C. Electrical Metallic Tubing

1. EMT used for power feeder or branch circuits, shall not exceed 2-inch trade size. EMT used for control circuits and communications systems shall not exceed 4-inch trade size.

D. Polyvinyl Chloride Coated Rigid Galvanized Steel Conduit

1. All conduit mounting channels and supports shall be stainless steel. All new accessories shall be PVC Coated hot dipping rigid galvanized steel. U-bolts shall be specially formed and sized to snug fit the outside diameter of the conduit. All screws and bolts shall have PVC encapsulated heads. All nuts, bolts, screws, etc., which cannot be PVC coated shall be stainless steel.
2. The RGS/PVC conduit system shall be installed in accordance with manufacturer recommendations, using the proper tools specifically manufactured for installation of RGS/PVC conduit systems. The installer shall be certified by the RGS/PVC manufacturer to install PVC coated conduit systems. Any PVC coating damaged during the installation shall be either repaired in accordance with the manufacturers recommended procedures and materials, or the damaged conduit section replaced, as determined by the Engineer.
3. All materials utilized for a RGS/PVC installation shall be by a single manufacturer. The Contractor shall not utilize conduits from different manufacturers in a conduit system, or mix conduits, fittings, bodies and clams from different manufacturers.

E. Cellular Metal Floor Raceway

1. Installation limits shall be defined by NFPA 70.

F. Flexible Metal Conduit

1. Install FSC for motor connections and for other equipment connections where subject to movement and vibration. Conduit shall be installed to permit maximum flexibility, without crushing or permanent deformation, and shall not exceed 18 inches in length, without approval of the Engineer.
2. Use LSC for the same installation conditions as FSC above, and where also subjected to one or more of the following conditions:
   a. Exterior locations;
   a. Condensating, moist, wet or humid conditions;
   b. Corrosive atmospheres;
   c. Water spray;
   d. Dripping oil, grease or water.

3. LSC installed within tunnel facilities, ventilation buildings, railroad/subway tunnels, and stations shall have a galvanized steel core with a low smoke, halogen free, polyurethane outer jacket.

4. PVC jacketing may be substituted for the low smoke, halogen free, polyurethane outer jacket only for non-tunnel, outdoor installations. PVC jacketing shall not be accepted as a substitute for installation within the tunnels, ventilation buildings, railroad/subway tunnels and stations.

5. Install FSC and LSC with a separate, insulated copper, code-sized, equipment grounding conductor, installed inside the flexible conduit.

G. Surface Metal Raceways

1. Only metallic surface metal raceways shall be permitted, unless otherwise shown on the Contract Drawings. Installation shall be in accordance with manufacturer's written recommendations and instructions accompanying the raceways.

2. Provide surface raceway system with means for assuring a continuous ground path throughout.

3. Use fittings without sharp edges introduced into any part of the raceway system.

H. Underfloor Raceways

2. Install underfloor raceways in accordance with the Contract Drawings NFPA 70, ANSI/UL 884, and the recommendations and requirements of the manufacturer.

I. Polyvinyl Chloride (PVC) Conduit

1. PVC Conduit shall not be used indoors.

2. PVC Conduits Types 40 and 80 conform to NFPA 70 Article 347 except it shall not be used indoors.

3. PVC Conduits Types 40, A and EB shall be used for concrete encasement.

4. PVC Conduit Type DB shall be used for direct burial, sand encased.

J. High-Density Polyethylene (HDPE) Conduit

1. HDPE conduit shall not be used indoors.

2. HDPE Type 40 shall be used for direct burial or encased in concrete.

K. Fiberglass Reinforced Epoxy (FRE) Conduit

1. Shall be installed as described in NFPA 70.

2. All sweeps, bends, or changes in direction shall be done with fittings only.

3. All conduit elbows, joints, bodies, condulets and fittings shall be manufactured from the same materials and of a construction type identical to the conduit.

   a. Where type FRE-XW conduit is installed, type FRE-S bodies and condulets may be utilized for trade size where type FRE-XW conduit bodies are not manufactured.

4. All FRE conduit joints shall be of the epoxy adhesive type. When cured, the epoxy joint shall be as strong as the conduit itself and completely watertight.

5. The FRE conduit system shall be installed in accordance with manufacturer recommendations, using the manufacturers recommended tools and methods. Any part of the FRE conduit system damaged during the installation shall be either repaired in accordance with the manufacturers recommended procedures and materials, or the damaged conduit section replaced, as determined by the Engineer.

6. All materials utilized for a FRE installation, including elbows, fittings, joints and joint epoxy shall be by a single manufacturer. The Contractor shall not utilize conduits and associated materials from different manufacturers in a conduit system, or mix conduit, fitting, couplings and joint epoxy from different manufacturers.

L. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals, which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.
2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

3.02 FIELD TESTS

A. Conduit Cleaning and Testing

1. After installation of conduits and accessories and completion of all concreting operations, if any, carefully clean and clear all conduit runs of all obstructions and foreign matter to the satisfaction of the Engineer.
2. Test conduits, in the presence of the Engineer, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter not more than 1/4 inch smaller than the inside diameter of the conduit, but nominally 85 percent of the trade diameter, whichever is larger. Only nylon cable of adequate strength shall be used to pull the mandrel through the conduit system. The use of rope shall not be permitted.

B. Connections to Existing Conduits

1. Where conduits installed under this Contract are connected to existing conduits, or conduits installed by others, test the entire run to the nearest box, manhole, handhole, or equipment enclosure as specified in this Section.
2. Report immediately to the Engineer any defect or stoppage found in portions of the conduit system not installed under this Contract. Do not attempt to rectify any defect or stoppage found in conduit not installed under this Contract unless specifically instructed to do so by the Engineer. The Contractor's compensation for the rectifying of such defects or stoppages at the direction of the Engineer shall be determined in accordance with the Clause of the Contract providing compensation for Extra Work.
3. The Engineer shall be the sole judge as to whether a defect or stoppage exists. Perform all tests required by the Engineer to enable the engineer to make a decision.

END OF SECTION

SECTION 16110

RACEWAYS

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following in accordance the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Raceway systems - only when shop drawings are required by the Contract Drawings

B. Catalog Cuts

1. Conduit and Tubing
2. Surface Metal Raceway and Accessories
3. Under floor Raceway and Accessories
4. Wireways and Auxiliary Gutters

C. Certifications

1. For FRE installations utilizing zero-halogen FRE, submit manufacturers' certification that no FRE conduit, fittings, and accessories exceed the toxicity levels specified in paragraph 2.01 J3 when tested in accordance with ASTM E800.
2. For FRE /PVC installations, submit proof of installer certification by the FRE /PVC manufacturer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16114

CABLE TRAYS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for metallic and non-metallic cable trays and their accessories.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM A 153	Standard Specification for Zinc Coatings (Hot Dip) on Iron and Steel Hardware
ASTM A 123	Standard Specification for Zinc Coatings (Hot Dip) on Assembled Steel Products
ASTM A 653	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
ASTM A 568	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low Alloy, Hot-Rolled and Cold-Rolled Sheet, General Requirements for
ASTM D 150	Standard Test Methods for AC Loss Characteristics and Permitivity (Dielectric Constant) of Solid Electrical Insulation
ASTM D 696	Standard Test Methods for Coefficient of Linear Thermal Expansion of Plastics
ASTM D 2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 162	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
ASTM E 662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM A 924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
	Military Specification (MIL)
MIL C 24643	Cable and Cord, Electrical, Low Smoke for Shipboard use, General Specification

National Electrical Manufacturers' Association (NEMA)

NEMA FG 1	Fiberglass Cable Tray Systems
NEMA VE 1	Metallic Cable Tray Systems

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 258	Standard Research Method for Determining Smoke Generation of Solid Materials

Underwriters Laboratories (UL)

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The cable trays shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ASTM, NEMA, NFPA, UL and MIL. SPEC. Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

1.04 QUALITY ASSURANCE

Cable trays of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURER

Subject to compliance with requirements of this Section, provide cable tray products of one of the manufacturers listed on the Contract Drawings.

2.02 CONSTRUCTION FEATURES

A. Cable trays shall be furnished as a complete system, including, but not limited to, all necessary fasteners, old-down clips, connectors, support systems, barrier strips, covers, horizontal and vertical fittings including elbows, reducers, tees and crosses. The cable tray system shall be in accordance with the requirements of NFPA 70.

B. Cable tray fittings shall be fully assembled by the manufacturer.

C. As shown on the Contract Drawings, cable tray shall be ventilated or non-ventilated, and of the ladder, trough, solid bottom or channel-type, with or without covers of the ventilated or non-ventilated type.

D. Cable tray size shall be as shown on the Contract Drawings. The minimum size shall be:

1. Width: 12 inches (inside)
2. Depth: 4 inches (outside)
3. Radii of Fitting: 24 inches (inside)

2.03 METALLIC CABLE TRAYS

A. Material

As shown on the Contract Drawings, the material shall be:

1. Galvanized Steel
   a. Ladder, trough and solid bottom cable trays
      (1) Hot dipped after fabrication
      (2) Minimum 16 gauge
      (3) The material and galvanizing process shall be in accordance with the following: ASTM A 123 ASTM A 153 ASTM 568ASTM A 653 ASTM A 924.
2. Aluminum
   a. Ladder and trough cable trays
      (1) Aluminum alloy shall be 6063-T6
   b. Solid bottom cable trays
      (1) Aluminum alloy shall be 5052
      (2) Corrugated construction
   c. Cover
      (1) Aluminum alloy shall be 3003
      (2) Solid flanged construction

B. Connectors

Connectors for tray sections shall be universal for use on straight sections and fittings. Connectors shall be of the high pressure, bolted type with the required number of bolts.

2.04 NON-METALLIC CABLE TRAYS

A. Splice plate fasteners shall be fiberglass encapsulated stainless steel. Fasteners must be capable of withstanding torque of 10 foot-pounds, without damage to threads or encapsulated coating.

B. Material

1. Cable trays shall be of pultruded glass reinforced polyester, meeting the following standards:

   ASTM D 2583, ASTM D 696, ASTM D 150ASTM E 162, ASTM E 84

2. The completed assembly shall pass the smoke generation test for both flaming and non-flaming when tested in accordance with ASTM E 662 and NFPA 258.Smoke density shall be measured by using the Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials in NFPA 258.

3. Halogen content not to exceed 0.2 percent when tested in accordance with MIL C 24643.

4. Flammability classification in accordance with UL 94.

C. Physical Properties

The manufacturer shall provide values for Mechanical, Electrical, Fire Retardant, Thermal Bending and Other Properties of the cable tray products in reference to related ASTM, NEMA, NFPA, UL, MIL SPEC Standards for the Purchaser's review

D. Veil

Glass reinforced polyester components shall have a dacronnexus veil applied to exterior surfaces to improve weatherability and inhibit ultraviolet degradation. An ultraviolet stabilizer shall be incorporated into the resin formulation in order to further inhibit ultraviolet degradation.

2.05 STRUCTURAL DESIGN

A. Cable tray shall be of ladder type design having "C" or "I" shaped side rails for metallic tray and "C" or "E" shaped side rails for non-metallic tray, as shown on the Contract Drawings.

B. Rungs shall be of the same material as the side rail and securely bonded in place. Rungs shall be mechanically locked into place by means of an intermediate side rail flange to prevent rollover when cables are pulled into the tray.

C. Unless otherwise shown on the Contract Drawings, cable tray sections shall be 20 feet in length (+/- 1/8 inch) excluding splice plates. Each straight section shall be furnished with pre-punched holes for splice plate attachment.

D. Tray system design shall meet or exceed loading capabilities in accordance with NEMA VE 1 and NEMA FG 1for Metallic and Non-metallic trays, respectively.

E. The fully loaded tray shall also be capable of supporting a 200 lb. concentrated static load at mid-span without failure or permanent deflection.

F. Manufacturer shall provide certified test data to verify compliance with above loading and deflection data.

2.06 WARNING SIGNS

Furnish and install warning signs, wording and layout as shown on the Contract Drawings.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install cable tray in conformance with NEMA VE 1, NEMA FG 1 and NFPA 70 requirements, in accordance with the manufacturer's instructions and the following minimum requirements:

1. Cable tray shall be installed as a complete and continuous system, using the manufacturers standard fittings, from source to termination.

2. Drop-offs, take-offs, or extensions from cable tray system shall be via raceways approved by the Engineer. Raceways shall be fastened to the cable tray system using fittings approved or listed by a qualified electrical testing laboratory. Open or exposed cable leaving a cable tray system without a raceway is not permitted.

B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 feet, maximum.

C. Use expansion connectors where indicated in NEMA VE 1 and NEMA FG 1.

D. Cut standard straight sections to length in field.

E. Install warning signs, not to exceed 50 foot on center, on each side of the cable tray, along the route of the cable tray, located to be visible from the floor level.

F. Provide bonding continuity between metallic cable tray sections and fittings in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 16114

CABLE TRAYS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16114A01 Shop Drawings
a. Outline drawings showing straight sections, horizontal and vertical fittings, connectors, covers and supports.
b. Outline drawings showing dimensions, support points and weights of the sections and fittings.
c. Bill of material for all equipment including description and part number
d. Installation instruction including list of special tools required for field installation.

Product Data

16114D01 Submit data on the physical properties of the cable tray system as specified in 2.04 of this Section.

END OF APPENDIX "A"

DIVISION 16

SECTION 16115

UNDERGROUND CONDUIT SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for underground conduits, manholes, handholes, vaults and accessories.

B. Definitions

1. Conduit: A single enclosed raceway for wires or cables; duct.
2. Ductbank: A structure containing one or more ducts or conduits.
3. Conduit System: A combination of conduit, conduits, manholes, handholes and vaults joined to form an integrated whole.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 2	National Electrical Safety Code
ANSI C 80.1	Rigid Steel Conduit - Zinc Coated
	American Society for Testing and Materials (ASTM)
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
	Institute of Electrical and Electronics Engineers, Inc. (IEEE)
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding
	National Electrical Manufacturers Association (NEMA)
NEMA RN 1	Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	Electric Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 14	Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
OSHA	Occupation Safety and Health Administration
	Underwriters Laboratories Inc. (UL)
UL 6	Rigid Metal Conduit
UL 514B	Fittings for Conduits and Outlet Boxes

UL 467	Electrical Grounding and Bonding Equipment
UL 651	Schedule 40 and 80 Rigid PVC Conduit
UL 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The underground conduit system shall be furnished and installed in accordance with this Section and as specified on the Contract Drawings.

A. Components of the underground conduit system manufactured, supplied, and installed shall comply with the requirements of NFPA 70, all local codes, and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. The manufacturer shall have had a minimum of three years experience within the last five years in manufacturing the products of the type(s) and size(s) described in this Section. Those products shall have been satisfactorily used for purposes similar to those intended herein. The Contractor shall provide a list of installations and contracts for which the manufacturer has produced such materials.

B. All electrical materials and equipment for which there is a nationally recognized standard, shall bear the conformance label of the nationally recognized third party inspection authority, such as Underwriters Laboratories Inc. (UL), Factory Mutual (FM) or ETL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging. Protective caps shall be removed immediately prior to installation of conduit.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

1.06 SUBMITTALS

For submittal requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Location, types and sizes of conduits and conduit systems are shown on the Contract Drawings.

2. Conduits shall be supplied in standard lengths in accordance with applicable UL standards.

3. Unless otherwise shown on the Contract Drawings, conduit or duct shall be type RGS as specified in this Section.

B. Rigid Metal Conduit

1. RGS - Galvanized steel conduit (heavy-wall) shall be hot dipped galvanized after cutting and threading and shall conform to UL 6 and ANSI C 80.1.

2. RGS-PV - PVC coated, galvanized steel conduit (heavy-wall) shall be hot dipped galvanized after cutting and threading, shall be coated with 40 mils of PVC and shall conform to NEMA RN 1, Type A 40.

3. All preformed elbows shall be similar in construction to and of a type designed for use with the appropriate conduit and shall conform to UL 6.

4. All fittings shall be threaded.

C. Rigid Nonmetallic Conduit

1. PVC-T - Schedule 20 (thin-wall) polyvinyl chloride (PVC) conduit shall conform to UL 651A.

2. PVC-H - Schedule 40 (standard-wall) polyvinyl chloride (PVC) conduit shall conform to UL 651.

3. PVC-80 - Schedule 80 (extra heavy-wall) polyvinyl chloride (PVC) conduit and elbows shall conform to NEMA TC 2 and UL 651.

4. Fiberglass reinforced epoxy conduit shall be glass filament wound, embedded in ultra-violet resistant epoxy. Conduit fittings and elbows shall conform to NEMA TC 14 and the following:

   a. FGS-T - Standard-wall conduit, wall thickness shall be not less than 70 mils for all sizes. Type FGS-T conduit shall be used only where encased in concrete.

   b. FGS-S - Heavy wall conduit, UL listed, with a wall thickness not less than 70 mils for conduits less than 4 inch trade size, not less than 90 mils for conduits 4 inch trade size and not less than 110 mils for conduits larger than 4 inch trade size. Type FGS-H shall be used where direct buried, encased in concrete, or where conduit risers extend to above grade, in accordance with the requirements of the UL listing.

   c. FGS-E - Extra-heavy wall conduit, with a wall thickness not less than one-quarter inch. Type FGS-E conduit shall be used for exposed exterior conduit runs on bridges and elevated structures.

5. Elbows, fittings, offsets, etc. shall be preformed and similar in materials and construction to the conduit.

6. Couplings shall be of a type to provide a watertight installation of the conduit system.

D. Manholes, Handholes, and Vaults

1. Precast manholes, handholes and vaults shall be as shown on the Contract Drawings. Concrete shall be in accordance with the requirements of Division 3 Section on concrete.

2. Cast-in-place manholes, handholes and vaults conforming in size and strength to the precast manholes, handholes and vaults shown on the Contract Drawings may be substituted, subject to the approval of the Engineer.

3. Continuous inserts shown on the Contract Drawings shall be hot-dipped galvanized steel, and shall be supplied complete with end caps and waxed cardboard closure strips. All metallic parts shall have a hot-dipped galvanized finish.

4. Racking assemblies shall be capable of being mounted on the continuous inserts supplied in manhole, handhole and vault walls, without modification, utilizing hot-dipped galvanized spring nuts and bolts.

   a. The racking assemblies shall, at a minimum, include supports on each wall of the manhole, handhole or vault, with arms on each support for each cable or arc-proofed cable group. Each arm shall have insulators to support each cable or cable group. Provide additional arms and insulators as shown on the Contract Drawings.

   b. Racking assembly arms and insulators, for installation on existing supports, shall match the existing supports without modification.

5. Manhole, handhole and vault frames and covers shall be as shown on the Contract Drawings.

6. Provide pulling hooks shall be Hubbard Co. No. 9119, or approved equal.

E. Grounding Assemblies

1. Grounding bushings shall be plated malleable iron body, insulated type, rated 150 degrees C.

2. Ground rods shall be minimum 3/4-inch diameter, copper-clad steel. Unless otherwise shown on the Contract Drawings, ground rods shall be 10 feet long.

3. Unless otherwise shown on the Contract Drawings, conductors for grounding assemblies within manholes, handholes, or vaults shall be copper, minimum #4 AWG.

4. Ground rod connections shall be either exothermic welds, or high-strength compression-crimp system conforming to the requirements of IEEE 837 and UL 467, or approved equal.

5. Ground cable clamps shall be split-bolt, high strength, copper alloy connectors.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all conduit, equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and existing underground utilities.

3.03 INSTALLATION

A. General

Underground conduit systems shall be installed in accordance with the requirements of ANSI C 2, NFPA 70 and as shown on the Contract Drawings.

B. Excavation and Backfill

Excavation and backfill for underground conduits, handholes, manholes and shall be in accordance with the applicable requirements of the Section entitled "EXCAVATION, BACKFILLING AND FILLING" of these Specifications.

C. Concrete Encased Conduit

1. Concrete encasement of conduit shall conform to the details shown on the Contract Drawings and the requirements of Division 3 Section on concrete.
2. The dead-ending of conduit shall be accomplished as shown on the Contract Drawings.
3. No variation from a straight line of greater than 1/2 inch in fifty feet will be permitted when installing a concrete encased conduit.
4. Reinforce junctions with existing concrete encased conduit, or existing systems, with W8 x W4 - 10 x 10 welded wire fabric, conforming to ASTM A 185, encased in four inches additional thickness of concrete around each set of conduits. The additional encasement shall extend at least four feet in each direction from the junction.
5. Where the placing of concrete is interrupted for one hour or more, reinforce the concrete encasement at the point of interruption with W4 x W4 - 10 x 10 welded wire fabric, conforming to ASTM A 185.
6. Preformed or precast conduit may be substituted for the field-encased type, subject to the approval of the Engineer. All precast conduit shall meet the same requirements specified herein or shown on the Contract Drawings.
7. All conduits shall leave or enter structures perpendicularly.
8. Changes in direction of conduits shall be made by bends having a minimum radius of 15 feet. Elbows or sweeps to equipment or foundations shall have a radius not less than 10 times the trade diameter of the conduit.
9. Conduits shall be installed in true alignment and shall be sloped for drainage toward manholes or handholes. All free ends of empty conduits shall be sealed to prevent water entrance.
10. Openings for conduits in manhole construction shall be sealed and made watertight in an approved manner.
11. Transitions between conduits of different materials shall be made using the manufacturer's standard adapters.
12. Terminations of rigid nonmetallic conduits in manholes, handholes, and other concrete structures, shall be made with end bells, set flush with the inside face of the concrete.

13. Terminations of rigid metal conduits in manholes, handholes, vaults and other concrete structures, shall be made with insulated grounding bushings, projecting 2 inches beyond the inside face of the concrete.

D. Direct-Buried, Rigid Nonmetallic Conduit (PVC-H or FRE)

1. Direct-buried conduits shall be laid on firmly tamped and graded stone-free sand not less than 2 inches deep. Backfill in contact with the conduits shall be sand to a minimum of 3 inches above the conduits and the remainder of the backfill shall be unfrozen, stone-free earth. Buried depth shall be as shown on the Contract Drawings.

2. Conduit entering or exiting manholes, handholes, vaults and other concrete structures shall be a 10-foot length of rigid metal conduit protected with two coats of asphaltic paint.

3. Terminations of conduits in manholes, handholes, vaults and other concrete structures shall be made with insulated grounding bushings projecting 2 inches beyond the inside face of the concrete.

E. Manholes, Handholes, and Vaults

1. Set precast manholes, handholes and vaults so that they are firmly and fully bedded at required grades.

2. Set frames and covers using mortar and masonry as required. Radially laid concrete brick shall have 1/4-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar and completely fill all joints. Where more than one course of concrete brick is required, stagger vertical joints.

3. Set racking assemblies as required so that the unsupported length of wires or cables shall not exceed 30 inches.

F. Vertical Adjustment of Existing Manholes, Handholes, and Vaults

1. Adjust the top elevation of existing structures to suit new finished grades in accordance with the details shown on the Contract Drawings.

2. Existing frames and covers shall be carefully removed, cleaned of all mortar fragments to the satisfaction of the Engineer and reset at the required elevation in accordance with the requirements shown on the Contract Drawings.

G. Grounding

1. Install a complete grounding system in each manhole or vault, and in selected handholes shown on the Contract Drawings. Electrically bond all arm supports, insulated grounding bushings, and ground rods together.

2. After installation, coat all bare surfaces or connections in the grounding system with asphaltic paint.

H. Testing

1. Test conduits, in the presence of the Engineer, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter not more than 1/4 inch smaller than the inside diameter of the conduit, but nominally 85 percent of the trade diameter, whichever is larger. Only nylon cable of adequate strength shall be used to pull the mandrel through the conduit system. The use of rope will not be permitted.

I. Connections to Existing Conduits

1. Where conduits installed under this Contract are connected to existing conduits, test the entire run to the nearest box, manhole, handhole, vault or equipment enclosure, including all existing conduits installed by others, that will be used under this Contract.

2. Where any work shall be performed in conduits emanating from a manhole, handhole, vault or equipment enclosure, all existing spare conduits (conduits containing no electric wire or cable) shall be tested to the nearest manhole, handhole, vault or equipment and a pull line shall be left in place in each such conduit.

3. Report immediately to the Engineer any defect or stoppage found in portions of the conduit system not installed under this Contract. Do not attempt to rectify any defect or stoppage found in conduit not installed under this Contract unless specifically instructed to do so by the Engineer. The Contractor's compensation for the rectifying of such defects or stoppages at the direction of the Engineer will be determined in accordance with the clause of the Contract providing compensation for Extra Work.

4. The Engineer shall be the sole judge as to whether a defect or stoppage exists. Perform all tests required by the Engineer to enable him to make his decision.

3.04 ADJUSTMENTS

A. Conduit Cleaning

After installation of conduits, manholes, handholes, vaults, accessories and completion of all concreting operations, if any, carefully clean and clear all conduits of all obstructions and foreign matter to the satisfaction of the Engineer.

END OF SECTION

SECTION 16115

UNDERGROUND CONDUIT SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16115A01 Handholes.

16115A02 Vaults.

16115A03 Frames and covers.

16115A04 Manholes, including "exploded" views with complete details as to the location of all existing and new conduits, wires and cables identified by permanent feeder numbers, racking assemblies and grounding assemblies. Manhole drawing blanks will be furnished by the Engineer.

Catalog Cuts

16115B01 Conduit.

16115B02 Racking assemblies.

16115B03 Grounding assemblies.

16115B04 Continuous inserts

END OF APPENDIX "A"

DIVISION 16

SECTION 16120

WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wires, cables, splices, terminations, and appurtenances for electrical systems of 600 volts or less.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM B 1	Hard-Drawn Copper Wire
ASTM B 2	Medium-Hard-Drawn Copper Wire
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 174	Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B 189	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ASTM D 2802	Ozone-Resistant Ethylene-Propylene-Rubber Insulation for Wire and Cable
ASTM D 3005	Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
ASTM E 662	Standard Test Method for specific Optical Density of Smoke Generated by Solid Materials

Federal Specifications (FS)

HH-I-553	Insulation Tape, Electrical (Rubber, Natural and Synthetic)

Insulated Cable Engineers Association (ICEA)

ICEA S-19-81	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 3)

ICEA S-61-402	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 5)
ICEA S-66-524	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 7)
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 8)
ICEA T-33-655	Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 383	Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding

Military Specifications

MIL C-24643	Electrical Cable and Cord for Shipboard Use, Testing for Low Smoke and Halogens

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code

Naval Engineering Standards

NES 713	Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials

Underwriters Laboratories Inc. (UL)

UL 44	Rubber-Insulated Wires and Cables
UL 62	Flexible Cord and Fixture Wire
UL 83	Thermoplastic-Insulated Wires and Cables
UL 467	Grounding and Bonding Equipment
UL 510	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 854	Service-Entrance Cables
UL 1581	Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 1685	Standards for Safety Vertical Tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables

1.03 QUALITY ASSURANCE

A. Wires and cables which have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

B. Tapes for splices or terminations shall be dated by the tape manufacturer to indicate that they have been manufactured no longer than six months prior to use in the Work of this Section.

C. Polyvinyl Chloride (PVC): PVC-insulated power wiring and items containing PVC, except PVC-insulated wiring for communications systems, remote control, signaling, and power-limited circuits, shall not be installed in indoor area. PVC-insulated wiring for communications systems, remote control, signaling, and power-limited circuits shall be furnished and installed in accordance with NFPA 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Single conductor wire or cable sizes #4/0 AWG and larger that are to be installed in the same raceway shall be paralleled by the cable manufacturer prior to shipment. Cable assembly overall diameter shall be kept to a minimum.

B. Wire and cable sizes #4/0 AWG and larger shall be provided with fctory-applied caps unless otherwise shown on the Contract Drawings. End seals shall be heat-shrink, irradiated, modified polyolefin, and shall be sized for individual wires and cables.

C. Store material in a clean, dry space and protect it from the weather.

1.05 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide wires, cables, wire and cable splicing, terminating and arcproofing materials of manufacturers as shown on the Contract Drawings.

2.02 WIRES AND CABLES

A. General

1. Definitions

a. Wire shall be defined as a solid or stranded conductor smaller than No. 6 AWG with or without insulation.

b. Cable shall be defined as a single conductor No. 6 AWG or larger, or two or more conductors of any size wire under a common covering.

2. Locations, types, sizes and numbers of wires and cables are shown on the Contract Drawings. Where not indicated, provide proper wire and cable selection to comply with this section and NFPA 70 Standards.

3. Unless otherwise shown on the Contract Drawings, solid conductors shall be soft or annealed copper, conforming to ASTM B 33 (tinned), ASTM B 189 (lead-coated or lead-alloy coated), or ASTM B 3 (uncoated). Unless otherwise specified in this Section or unless otherwise shown on the Contract Drawings, stranded copper conductors shall be concentric stranding conforming to ASTM B 8.

4. Unless otherwise shown on the Contract Drawings, cable jackets for interior use shall be low smoke, low toxicity, non-halogen, flame retardant type and shall meet the following performance characteristics:

   a. Cables shall pass the flame propagatory and smoke release criteria according to the test method of UL 1685.

   b. The halogen content of cable jackets shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

   c. The toxicity index of cable jackets shall not exceed 4.0 according to the test method of NES 713.

   d. The cable jackets shall comply with ICEA T-33-655 for smoke generation.

   e. The acid gas content of cable jackets shall not exceed a maximum of 3.0 percent according to the test method of MIL-C-24643.

5. Use the additional performance characteristics for wires and cables which will be installed in subway areas, substations, tunnels, etc. where stringent flame retardency, low smoke, low toxicity, zero halogen and good circuit integrity during a fire are required.

   a. Wires shall pass the flame propagatory criteria according to the test method of VW-1.

   b. The halogen content of both the wire and cable insulation and cable jacket(s) shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

   c. The toxicity index of both the wire and cable insulation and cable jacket(s) shall not exceed 2.0 according to the test method of NES 713.

   d. The acid gas content of both wire and cable insulation and cable jacket(s) shall not exceed a maximum of 2.0 percent according to the test method of MIL-C-24643.

e. The wire and cable insulation materials shall pass the smoke generation test in accordance with ASTM E 662. Wire and cable insulation when tested on a specimen of 80 mils thick slab shall not exceed the following values:

Flaming Avg. Ds (4 minutes)	100
Flaming Avg. Dm (20 Minutes)	200
Non-Flaming Avg. Ds (4 minutes)	100
Non-Flaming Avg. Dm (20 minutes)	350

f. The cable jacket materials shall pass the smoke generation test in accordance with ASTM E 662. Wire and cable jacket when tested on a specimen of 80 mils thick slab shall not exceed the following values:

Flaming Avg. Ds (4 minutes)	50
Flaming Avg. Dm (20 minutes)	150
Non-Flaming Avg. Ds (4 minutes)	50
Non-Flaming Avg. Dm (20 minutes)	250

6. Color-Coding for Power and Lighting Conductors

a. Insulation or covering of wires and cables shall be factory color-coded by the use of colored compounds or coatings. The color-code shall be followed cnsistently throughout the performance of the Work.

b. Upon written request of the Contractor, the Engineer may permit the use of the following methods in lieu of the wire or cable manufacturer's color-coding, when limited quantities of wire and cable are involved, for sizes #8 AWG and larger.

(1) For dry locations only, spiral application of 3/4 inch wide, colored pressure sensitive plastic tape, half lapped for a distance of not less than six inches may be used. To prevent unwinding, the last two wraps of tape shall be applied with no tension.

(2) For wet or dry locations, application of three, 3/16 inch wide, colored, fungus-inert, self-extinguishing, self-locking, nylon cable ties spaced 3 inches apart may be used. The ties shall be snugly applied with a special tool or pliers, and any excess removed.

(3) Each wire and cable shall be color-coded at all terminal points, in all manholes, boxes, or other similar enclosures.

(4) Color markings shall be applied so as not to obliterate the manufacturer's identification markings.

c. Color code chart shall be as follows:

	System Voltage	
Conductor	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

7. All wires, cables, splices and terminations, for which there are established UL standards, shall bear the UL label.

B. General-Purpose Wires and Cables

Unless otherwise shown on the Contract Drawings, general purpose wires and cables shall be as follows:

1. General-purpose wires and cables shall be single conductor, ASTMB8, Class B stranded for sizes #8 AWG and larger, and solid for sizes #10 AWG and smaller.

2. Select from the following list of UL wire and cable types:

a. Type XHHW: Flame retarding, Cross-linked-polyolifin insulation, conforming to UL 44, for dry locations only.

b. Type XHHW-2: Flame retardant, Cross-linked-polyolifin insulation, conforming to UL 44.

c. Type THWN: Flame retardant, moisture and heat resistant thermoplastic insulation with a nylon jacket or equivalent; Double rated THHN-THWN gasoline-oil resistant II; conforming to UL 83.

The use of this cable shall be in accordance with the requirements of paragraph 1.03C of this Section.

d. Type USE: Heat and moisture resistant ethylene- propylene-rubber insulation with heavy duty thermosetting chlrosulphanated polyethylene or heavy- duty neoprene jacket; multiple rated "USE-RHH-RHW"; conforming to ASTM D 2802, ICEA S-68-516, UL 44 and UL 854. Unless otherwise indicated, Type USE shall be the only wire and cable used for underground installations.

C. Overhead Service Cables

Unless otherwise shown on the Contract Drawings, overhead service cables shall be two or more type SE, ASTM B 8, Class B or Class C stranded, hard-drawn copper conductors, ethylene-propylene-rubber insulation, with heavy duty neoprene or heavy duty thermosetting chloro-sulphonated polyethylene jacketed, marked "sunlight resistant", conforming to ASTM D 2802, UL 44 and UL 854. Cable shall be factory assembled with copper-clad messenger conforming to ICEA S-68-516.

D. Portable Cords

Unless otherwise shown on the Contract Drawings, portable cords shall be as follows:

1. Type S shall be 60 degrees C rated, with heavy-duty thermosetting insulation and jacket, conforming to UL 62, 600-volt rated.
2. Type SO shall be oil resistant, 60 degrees C rated, with heavy-duty thermosetting insulation and jacket, conforming to UL 62, 600-volt rated.
3. Type G or Type W shall be 90 degrees C rated, with ethylene-propylene-rubber insulation and Hypalon jacket, 600-volt rated.
4. Special types shall be used only where shown on the Contract Drawings.

E. Lighting Fixture Wires

Unless otherwise shown on the Contract Drawings, lighting fixture wires shall be stranded only, and shall be Type SF-2, silicone rubber insulated conforming to UL 62.

F. Grounding Wires and Cables

Unless otherwise shown on the Contract Drawings, grounding wires and Cables shall be as follows:

1. Insulated
   a. Solid for sizes #8 AWG and smaller; ASTM B 8, Class B stranded for sizes #6 AWG and larger; and of the same insulation type as the power conductors.
   b. Covering shall be a continuous green color and conform to ASTM B 33 and UL 44.
2. Uninsulated
   a. General

      Solid for sizes #8 AWG and smaller; ASTM B8, Class B stranded for sizes #6 AWG and larger.

   a. In raceways

      Soft-drawn and conforming to ASTM B 3.

   b. Direct buried or encased in concrete

      Soft-drawn, medium-hard-drawn, or hard-drawn and conforming to ASTM B 1, B 2 or B 3, respectively.

G. Control Wires and Cables

Unless otherwise shown on the Contract Drawings, control wires and cables shall be as follows:

1. Single conductor wires and cables shall be ASTM B 8, Class B stranded, type XHHW or XHHW-2 flame retardent, cross-linked-polyolifin insulation. Both shall conform to UL44 and ICEA S-66-524.

2. Multiconductor cables shall be ASTM B 8, Class B or Class C stranded, Control Cable Type B, conforming to ICEA S-61-402. Color-coded as per ICEA S-61-402, Method No. 1 for NFPA 70 applications (with white and green) or ICEA S-19-81, for paired conductor cables. Select from the following list of cable types.

a. Individual ethylene-propylene rubberinsulation with overall flame retardent, cross-linked-polyolifin jacket; conforming to ICEA S-68-516, UL 44, and UL 1581.

b. Individual ethylene-propylene-rubber insulation with individual and overall flame-retardent, cross-linked polyolifin jackets; conforming to ICEA S-68-516 and UL 44.

c. Individual flame retardent, cross-linked-polyolifin insulation with and overall flame retardent, cross-linked-polyolifin jacket; conforming to ICEA S-66-524.

d. Individual cross-linked-polyolifin insulation with overall polyvinyl chloride jacket conforming to ICEA S-66-524.

e. Individual polyolifin insulation with individual and overall polyvinyl chloride jackets conforming to ICEA S-61-402.

H. Switchboard Wires and Cables

Unless otherwise shown on the Contract Drawings, switchboard wires and and cables shall be as follows:

1. Switchboard wires and cables shall be single conductor, ASTM B 8, Class B stranded, except that for wires and cables crossing hinged joints and swinging panels, and where "Extra Flexible" wire or cable is shown on the Contract Drawings, conductors shall be ASTM B 174, Class K stranded.

2. Wires and cables shall be Type SIS, cross-linked-thermosetting-polyethylene insulation, conforming to ICEA S-61-402, IEEE383 and UL 44.

I. Cable Tags

1. Dry Locations

a. Fiberglass tags, 1/16 inch thick and 3/4 inch wide, indented with letters and numbers 5/16 inch high, with #14 AWG copper or nylon, weather-resistant cable ties.

b. Lighting branch circuit wiring and single conductor signal and control wiring may be identified with "Quiklables" manufactured by W. H. Brady Company, or approved equal.

2. Wet Locations

Stainless steel metal tags, No. 28 gauge and 3/4 inch wide, embossed with letters and numbers 5/16 inch high, with #14 AWG copper or nylon, weather-resistant cable ties, or stainless steel cable ties.

2.03 SPLICING, TERMINATING AND ARCPROOFING MATERIALS

A. General

1. All splicing, terminating and arcproofing materials shall be compatible so that no one material will adversely affect the physical or electrical properties of any other, or of the wire or cable itself.

2. All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

B. Connectors

Subject to compliance with requirements of this Section, provide connectors of the following types:

1. Solderless, uninsulated, high conductivity, corrosion resistant, compression connectors conforming to UL 467 and IEEE 837;

2. Insulated, indenter type compression butt connectors;

3. Insulated, integral self-locking flexible shell, expandable spring connectors;

4. Uninsulated, indenter type compression pigtail connectors;

5. Welded type connectors.

C. Terminals

Subject to compliance with requirements of this Section, provide terminals of the following types:

1. Solderless, uninsulated, high conductivity, corrosion resistant, compression terminals conforming to UL 467 and IEEE 837;

2. Insulated, compression terminals;

3. Solderless, high conductivity, corrosion resistant, hex screw type, bolted terminals;

4. Welded type terminals.

D. Shrinkable Tubing

Subject to compliance with requirements of this Section, provide shrinkable tubing of the following types:

1. Either irradiated modified polyvinyl chloride or irradiated modified polyolefin heat shrinkable tubing;

2. Cold shrinkable tubing.

E. Tapes and Sealers

1. Vinyl Tapes

Flame-retardent, cold and weather-resistant, 3/4 inch or 11/2 inches wide, as required, and conforming to UL 510 and ASTM D 3005.

a. For interior, dry locations, provide 7 mils, conforming to ASTM D 3005 (Type I); Scotch (3M) No. 33, or approved equal.

b. For exterior or damp and wet locations, provide 8.5 mils, conforming to ASTM D 3005 (Type II); Scotch (3M) No. 88, or approved equal.

2. Rubber Tapes

Ethylene-propylene, rubber-based, 30-mil splicing tape, rated for 130 degrees C operation; 3/4inch and wider (1, 1 1/2, 2 inches) as shown on the Contract Drawings or approved by the Engineer, conforming to Federal Specification HH-I-553 (Grade A); Scotch (3M) No. 130C, or approved equal.

3. Insulating Putty

Rubber-based, 125-mil elastic filler putty; 1 1/2 inches wide; Scotch (3M) Scotchfil, or approved equal.

4. Silicone Rubber Tapes

Inorganic silicone rubber, 12-mil, 130 degrees C rated, anti-tracking, self-fusing tape; 1 inch wide; Scotch (3M) No. 70, or approved equal.

5. Sealer

Liquid applied, fast-drying sealant; Scotch (3M) Scotchkote, or approved equal.

F. Resin Filled Splices

1. Epoxy Molded Type

Two-piece, snap-together molded bodies, sized for wire or cable, with two-part low viscosity polyurethane insulating and sealing compound, rated for 600 volts, using crimp-type wire connector; Scotch (3M) No. 82-A1, 82-A2 or 82-A3 compound, or approved equal.

2. Re-Enterable Type

Transparent, molded bodies clamped with stainless steel strain-relief bar and shield continuity connectors, sized for wire or cable, with loosely woven polyester spacer web and jelly-like urethane formulation for permanent re-entry capability; Scotch (3M) No. 78-R1 thru 78-R5, with No. 2114 compound, or approved equal.

G. Arcproofing Materials

1. Fire resistant tapes shall be Scotch (3M) No. 77, or approved equal.

2. Glass cloth binding tapes shall be Scotch (3M) No. 69, or approved equal.

H. Special splicing materials and methods shall be as shown on the Contract Drawings.

2.04 SHOP TESTS

A. For quantities as shown on the Contract Drawings, regular dielectric-withstand and insulation-resistance in water tests for wires and cables shall be performed in accordance with UL44.

B. Flame tests for wires and cables shall be performed in accordance with IEEE 383.

C. The test results shall be certified for each reel/coil/box of wire or cable.

D. Factory inspection and witnessing of tests by the Engineer shall be required for all wires and cables furnished under this Contract. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests.

PART 3. EXECUTION

3.01 PREPARATION

A. Prior to pulling wires and cables, clean raceway systems of all foreign matter and perform all operations necessary so as not to cause damage to wires and cables while pulling.

B. Prior to pulling wires and cables into underground conduit systems, place a feeding tube approved by the Engineer at the entrance end of such systems.

3.02 INSTALLATION

A. Wire and Cable Installation

1. General

a. Keep wires and cables dry at all times.

b. Seal wire and cable ends with watertight end seals if splicing or terminating does not follow at once.

c. Before splicing or terminating wires and cables, make a thorough inspection to determine that water has not entered the wires and cables or that the wires and cables have not been damaged.

d. Use adequate lubrication when installing cables in conduits or raceways. Any pulling compounds shall be compatible with the finish of the wires and cables furnished.

2. General Purpose Wires and Cables

a. Minimum wire or cable size shall be #12 AWG for light and power service.

b. Wires or cables shall be at least #10 AWG for the entire length of branch circuits, where distances to first outlets are as follows:

(1) 100 feet or more on 480Y/277 Volt systems.

(2) 70 feet or more on 208Y/120 Volt systems.

3. Lighting Fixture Wires

a. For wiring within lighting fixtures only, where sizes #14 AWG or smaller are required, use Type SF-2 fixture hookup wire. Type SF-2 wire shall not be used for wiring end-to-end connected fluorescent fixtures.

b. For connecting lighting fixtures to branch circuit conductors, use either Type RHH-VW-1, XHHW or USE, up to 90 degrees C, in dry locations.

4. Grounding Wires and Cables

a. Use bare, uninsulated wire and cable only where shown on the Contract Drawings or where approved by the Engineer.

b. Insulated grounding cable shall be of the type specified in this Section or as shown on the Contract Drawings.

5. Control Wires and Cables

Control wires and cables shall not be smaller than #14 AWG unless otherwise shown on the Contract Drawings.

B. Splicing and Terminating

1. General

Splicing and terminating shall be as specified in this Section. Details of special splicing and terminating shall be as shown on the Contract Drawings. Any splicing or terminating methods other than those specified below, for which the components are in accordance with the requirements of this Section, shall be submitted to the Engineer for approval.

2. General Purpose Wires and Cables

a. Splices in dry locations for sizes #10 AWG and smaller

Splicing shall be completed using one of the following:

(1) Insulated, integral, self-locking flexible shell, expandable spring connectors shall be applied to the twisted conductors. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

(2) Compression type, insulated butt connectors shall be applied to the butted conductors by means of an appropriate crimping tool, providing controlled indentation. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

(3) Compression type, pigtail connectors shall be applied to the conductors by means of an appropriate crimping tool, providing controlled indentation. The connector shall be covered with a polyamide cap and two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

b. Splices in dry locations for sizes #8 AWG and larger

Splicing shall be completed using all of the following:

(1) Connectors shall be split sleeve solderless type or solderless compression type.

(2) Fill indents of connectors with Scotchfil insulation putty.

(3) Apply rubber splicing tape equal to the original insulation rating.

(4) Apply two, half-lapped layers of vinyl tape, or a shrinkable tubing.

c. Splices in wet locations

(1) Same as dry locations specified in 3.02B.2.a and 2.b, except that after vinyl tape is applied, cover with two coats of sealer or shrinkable tubing.

(2) Resin-filled splice shall be covered with two, half-lapped layers of vinyl tape and two coats of sealer or shrinkable tubing.

d. Terminations in dry locations for sizes #10 AWG and smaller

Terminations shall be compression terminals, insulated or uninsulated.

e. Terminations in dry locations for sizes #8 AWG through #3/0 AWG

(1) Ring tongue terminals shall be solderless, uninsulated compression crimp type.

(2) Ring tongue lugs shall be bolted hex screw type.

f. Terminations in dry locations for sizes #4/0 AWG and larger.

Ring tongue terminals shall be solderless, uninsulated compression crimp type.

g. Terminations in wet locations

In addition to the dry location terminations specified in 3.02 B.2.d, 2.e and 2.f, cover the entire termination area with two, half-lapped layers of vinyl tape and apply two coats of sealer over the tape.

3. Overhead Service Cables

Splices and terminations in overhead service cables shall be the same as specified in 3.02 B.2.c and 2.g, respectively, appropriate for overhead service.

4. Portable Cords

a. Splices shall not be made in portable cords.

b. Terminations shall be made only at apparatus to be served or at branch circuit connection by means of any of the following:

(1) Insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors;

(2) Insulated, crimp type, compression connectors;

(3) Uninsulated, ring tongue terminals for connection to wire terminal strip block.

5. Lighting Fixture Wires

Connections to branch circuit and to fixture wiring shall be made by either insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors.

6. Grounding Wires and Cables

a. Splices and terminations shall be installed in accordance with the manufacturer's recommendations.

b. In hazardous or classified locations, splices and terminations shall be solderless high conductivity, corrosion resistant, compression type connectors and terminations shall be clamp type pressure connectors, suitable for such use.

c. All underground connections shall be covered with two coats of asphalt base paint.

7. Control Wires and Cables

a. Splices shall be made in accordance with the requirements specified in 3.02 B.2.c and shall be enclosed in a re-enterable splicing case. Where shielded cable is shown on the Contract Drawings, the shielding shall be continued through the splice. Shields shall be grounded at one location only unless otherwise shown on the Contract Drawings.

b. Terminations shall be insulated, indenter type ring tongue terminals.

8. Switchboard Wires

a. No splices are permitted.

b. Terminations shall be insulated, indenter type ring tongue terminals.

C. Arcproofing

1. Arcproofing shall be applied where shown on the Contract Drawings.

2. Arcproofing, which has been disturbed for any reason, shall be reinstalled as soon as possible after the disturbance.

3. Arcproofing shall be installed as follows:

a. Wires and cables shall be grouped by circuit and arcproofing applied over the group of wires and cables comprising one circuit. Splices shall be arcproofed individually and the taping shall join with and be overlapped by the group taping.

b. Arcproofing shall be applied in two wrappings of half-lapped tape, bound with glass cloth tape applied at the ends of the fire resistant tape, and at intervals not to exceed 24 inches along the entire length of the cables. The two wrappings shall be applied with opposing-lays.

c. Arcproofing shall be extended into the conduit opening or end bell of the raceway entering a handhole, manhole or box.

d. Arcproofing tape shall be 1 1/2 inches wide where the diameter of the individual cable, or of the circumscribed circle for the circuit group, is less than 1 3/4 inches. For larger diameters, the tape shall be 3 inches wide.

D. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wireways and other enclosures and access locations, and at all terminal points.

2. The circuit designations shall be as shown on the Contract Drawings. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables which are arcproofed shall also be identified outside the applied arcproofing.

3.03 FIELD TESTS

Test all wires and cables up to equipment installed under this Contract with a 1000-volt Megohmmeter. Furnish the Engineer with a copy of the "Megger" readings together with an outline of the method used. If, in the opinion of the Engineer, any reading is lower than that required by applicable codes, promptly replace the materials involved, at the Contractor's expense, and retest.

END OF SECTION

SECTION 16120

WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

16120B01 Catalog Cuts
a. Wires and cables for each type and size
b. Splice kit materials and installation procedures

Manufacturer Test Reports

16120F01 Submit certified shop test reports for wires and cables.

Record Documents

16120M01 Submit field test results for wires and cables, including "Megger" readings with the test method used.

END OF APPENDIX "A"

DIVISION 16

SECTION 16121

WIRES, CABLES, SPLICES, TERMINATIONS

(MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wires, cables, splices, terminations and appurtenances for electrical systems of medium voltage: 601 volt to 34,500 volts, inclusive.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM B 1	Hard-Drawn Copper Wire
ASTM B 2	Medium-Hard-Drawn Copper Wire
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 29	Pig Lead
ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 189	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ASTM D 1373	Medium-Voltage Rubber Insulating Tape
ASTM D 2802	Ozone-Resistant Ethylene-Propylene-Rubber Insulation for Wire and Cable
	Association of Edison Illuminating Companies (AEIC)
AEIC CS-6	Ethylene-Propylene-Rubber Insulated Shielded Power Cable Rated 5 through 69 KV
	Federal Specifications (FS)
HH-I-553	Insulation Tape, Electrical (Rubber, Natural and Synthetic)

Insulated Cable Engineers Association (ICEA)

ICEA S-68-516	Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 48	High Voltage AC Cable Terminators, Test Procedure and Requirements
IEEE 383	Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations
IEEE 404	Standard for Type Test of Cable Joints for Use with Extruded Dielectric Cable Rated 5,000 through 46,000 Volts, and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500 through 500,000 Volts
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 258	Standard Research Method for Determining Smoke Generation of Solid Materials
OSHA	Occupation Safety and Health Administration

Underwriters Laboratories Inc. (UL)

UL 44	Rubber-Insulated Wires and Cables
UL 467	Grounding and Bonding Equipment
UL 510	Insulating Tape
UL 1581	Reference Standard for Electrical-Wires, Cables, and Flexible Cords.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Wires, cables, splices and terminations for medium voltage: 601 Volts to 34,500 Volts, inclusive, shall be furnished and installed in accordance with this Section and as specified on the Contract Drawings.

B. Components of the medium voltage system, manufactured, supplied and installed, shall comply with the requirements of NFPA 70, all local codes, and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. Wires and cables that have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

B. Tapes for splices or terminations shall be dated by the tape manufacturer to indicate that they have been manufactured no longer than six months prior to use in the Work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Where multiple single conductor cables are to be installed as one cable, single conductor cables shall be paralleled by cable manufacturer prior to shipment. Cable assembly overall diameter shall be kept to a minimum.

B. Store material in a clean, dry space and protect it from the weather.

1.06 SUBMITTALS

See Appendix A.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Provide wires, cables, splices and terminations, and ancillary equipment, in compliance with the requirements of this section, and as shown on the Contract Drawings.

2.02 MATERIALS

A. Wires and Cables

1. Locations, types, sizes and numbers of wires and cables are shown on the Contract Drawings.

2. Unless otherwise shown on the Contract Drawings, solid conductors shall be soft or annealed copper, conforming to ASTM B 33 (tinned), ASTM B 189 (lead-coated or lead alloy coated), or ASTM B 3 (uncoated).

3. Pulling Devices and End Seals

a. Wires and cables shall be provided with factory fitted pulling devices and end caps unless otherwise shown on the Contract Drawings. Shop drawings showing the pulling devices and end caps to be used shall be submitted to the Engineer for approval.

b. For pulling tensions up to 1000 pounds per grip, basket grips may be utilized.

c. All wires and cables shall be end-sealed, at both ends of each length. Lead cable shall be solder-wiped sealed with a heat-shrinkable cap, to prevent the entrance of moisture.

d. Lead-sheathed cables shall be provided with either compression type or solder-wiped style pulling bolts or eyes on the leading end of each conductor, or on the overall assembly. The pulling device shall be installed and fitted with either solder-wipe or heat-shrinkable sleeve to prevent the entrance of moisture.

4. Wires and cables shall be identified in accordance with AEIC CS 6. Outer jacket shall be printed with manufacturer's identification, type of insulation, size of conductor, rated voltage, year of manufacture, insulation thickness and UL listing. Each reel shall carry a tag identifying manufacturer, cable type, size, voltage and length of cable on reel.

   In addition, on each single conductor cable when shipped triplexed or paralleled, there shall be a unique series of "111" or "222" or "333" respectively per phase or leg to identify the phase connection.

5. Grounding Wires and Cables

   Unless otherwise shown on the Contract Drawings, grounding conductors shall be as follows:

   a. Insulated

      (1) Solid for sizes #8 AWG and smaller, Class B stranded for sizes #6 AWG and larger, 600 volt rated, XHHW or RHW.

      (2) Covering shall be a continuous green color and conform to ASTM B 33 and UL 44.

   b. Uninsulated

      (1) Solid for sizes #8 AWG and smaller, Class B stranded for sizes #6 AWG and larger.

      (2) In raceways

      Soft-drawn and conforming to ASTM B 3.

      (3) Direct buried or encased in concrete

      Soft-drawn, medium-hard-drawn or hard-drawn and conforming to ASTM B 1, B 2 or B 3, respectively.

6. Medium Voltage Flat Strap Cable, (FSC).

   a. Flat Strap Cable shall be used for all underground and outdoor locations unless otherwise shown on the Contract Drawings.

   b. Jacketed, single conductor cable.

      (1) Voltage rating shall be as shown on the Contract Drawings.

      (2) Insulation

      Insulation shall be Ethylene-Propylene-Rubber (EPR). Cables shall conform to AEIC CS-6, ASTMD-2802 and ICEA S-68-516.

      (3) General Construction

      In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

         (a.) Copper conductor shall be annealed, uncoated, compressed round strand or compact round strand when shown on the Contract Drawings.

         (b.) Extruded conductor shielding;

         (c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded semiconducting insulation shielding;

(e.) Flat strap neutral shall consist of tin coated, annealed flat copper wires per ASTM B272, helicaly applied over the insulation shield. The edges of the straps shall be rounded. The equivalent conductor size shall be #2 AWG unless otherwise shown. It shall cover not less than 80% of the insulation-shielding surface;

(f.) Jacket of linear low-density polyethylene (LLDPE) in accordance with ASTM D1248. The jacket thickness shall be 50 mils and shall conform to IPCEA and UL standards. For cable used for indoor locations, jacketing material shall be selected to receive the UL label for tray use;

(g.) Maximum outside diameter shall be as shown on the Contract Drawings;

c. Assembly

Unless otherwise shown on the Contract Drawings, cables shall be triplexed at the factory prior to shipping.

7. Medium Voltage Lead-sheathed Cables (For Exterior and Underground Use)

a. Lead-Sheathed Cable shall only be used where specifically shown on the Contract Drawings.

b. Jacketed, Single Conductor Cable

(1) Voltage ratings shall be as shown on the Contract Drawings.

(2) Insulation

Insulation shall be ethylene-propylene-rubber (EPR). Cables shall conform to AEIC CS-6; ASTM D 2802 and ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Copper conductor, annealed, uncoated, Class B stranded or compact strand or sector, as shown on the Contract Drawings;

(b.) Extruded conductor shielding;

(c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded EPR, semi-conducting, insulation shielding;

(e.) Lead sheath overall;

(f.) Jacket of black polyethylene, polyvinyl chloride, or as shown on the Contract Drawings.

(g.) Maximum outside diameter shall be as shown on the Contract Drawings.

c. Jacketed, Three Conductor Cable

(1) Voltage ratings shall be as shown on the Contract Drawings.

(2) Insulation

EPR insulated cables shall conform to AEIC CS-6 and ASTM D 2802, ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Three insulated, shielded conductors, each with:

i. Copper conductor, uncoated, Class B stranded or compact strand or sector;

ii. Extruded conductor shielding;

iii. Insulation shall be EPR, 133 percent insulation level;

iv. Extruded, semi-conducting, insulation shielding;

v. Copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap.

(b.) Ground conductors and fillers as necessary to provide an overall round cross section;

(c.) Tape binder over the three insulated, shielded conductors;

(d.) Lead sheath overall;

(e.) Jacket of black polyethylene, polyvinyl chloride, or as shown on the Contract Drawings.

(f.) Maximum outside diameter shall be as shown on the Contract Drawings.

8. Medium Voltage Cables (For Interior Use)

a. Jacketed, Single Conductor Cable

(1) Voltage ratings shall be as shown on the Contract Drawings.

(2) Insulation

Insulation shall be Ethylene-propylene-rubber (EPR). Insulated cables shall conform to AEIC CS-6, ASTM D 2802 and ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Copper conductor, uncoated, Class B stranded or compact strand or sector, as shown on the Contract Drawings;

(b.) Extruded conductor shielding;

(c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded EPR, semi-conducting, insulation shielding;

(e.) Tinned copper braided shield, 85% minimum coverage, or copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap;

(f.) Jacket of flame retardant, low smoke chemically cross-linked polyolefin (XLPO), or chlorosulfonated polyethylene (CSP), or as shown on the Contract Drawings.

(g.) Maximum outside diameter shall be as shown on the Contract Drawings.

b. Jacketed, Three Conductor Cable

(1) Voltage ratings shall be as shown on the Contract Drawings.

(2) Insulation

EPR insulated cables shall conform to AEIC CS 6 and ASTM D 2802, ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, three conductor cable shall consist of the following:

(a.) Three insulated, shielded conductors, each with:

i. Copper conductor, uncoated, Class B stranded or compact strand or sector;

ii. Extruded conductor shielding;

iii. Insulation shall be EPR, 133 percent insulation level;

iv. Extruded, semi-conducting, insulation shielding;

v. Tinned copper braided shield, 85% minimum coverage, or copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap.

(b.) Ground conductors and fillers as necessary to provide an overall round cross section;

(c.) Tape binder over the three insulated, shielded conductors;

(d.) Jacket of flame retardant, low smoke chemically cross-linked polyolefin (XLPO), or chlorosulfonated polyethylene (CSP) or as shown on the Contract Drawings.

(e.) Maximum outside diameter shall be as shown on the Contract Drawings.

9. Cable Tags

Stainless steel metal tags, No. 28 gauge and 3/4-inch wide, embossed with letters and numbers 5/16-inch high, fastened to the cable at both ends of tags with nominal 1/16-inch diameter monel metal wire or stainless steel cable ties.

10. Splicing, Terminating and Arcproofing Materials

a. General

(1) All splicing, terminating and arcproofing materials shall be compatible so that no one material will adversely affect the physical or electrical properties of any other, or of the wire or cable itself.

(2) All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

(3) Splices and terminations shall be supplied as complete kit assemblies with all components and detailed installation instructions. Unless otherwise shown on the Contract Drawings, splices and terminations for medium voltage cables shall be heat-shrink polymeric type as manufactured by Raychem.

b. Connectors

Subject to compliance with requirements of this Section, provide Split-sleeve, solder, high conductivity, corrosion resistant connectors.

c. Terminals

Subject to compliance with requirements of this Section, provide Solder type, high conductivity, corrosion resistant terminals.

d. Shrinkable Tubing

Subject to compliance with requirements of this Section provide shrinkable tubing of the following types:

(1) Either irradiated modified polyvinyl chloride or irradiated modified polyolefin heat shrinkable tubing.

(2) Cold, shrinkable tubing.

e. Tapes and Sealers

(1) Vinyl Tapes

Flame-retardant, cold and weather-resistant, 3/4 inch and 1 1/2 inches wide, as required, and conforming to UL 510 and ASTM D 3005.

(a.) For interior, dry locations, provide Tape 7 mils thick, conforming to ASTM D 3005 (Type I).

(b.) For exterior or damp and wet locations, provide tape 8.5 thick, mils conforming to ASTM D 3005 (Type II).

(2) Rubber Tapes

Ethylene-propylene, rubber-based, 30-mil splicing tape, rated for 130 degrees C operation; 3/4 inch and wider (1, 1 1/2, 2 inches) or as shown on the Contract Drawings, or as approved by the Engineer, conforming to ASTM D 1373 and Federal Specification HH-I-553 (Grade A).

(3) Insulating Putty

Rubber-based, 125-mil elastic filler putty; 1-1/2 inches wide; Scotch (3M) Scotchfil, or approved equal.

(4) Silicone Rubber Tapes

Inorganic silicone rubber, 12-mil 130 degrees C rated, anti-tracking, self-fusing tape; 1 inch wide.

(5) Sealer

Liquid applied, fast-drying sealant; Scotch (3M) Scotchkote, or approved equal.

f. Binding wire shall be uninsulated, tinned copper.

g. Lead sleeve shall be 5/32 inches thick, commercially and chemically pure, and shall conform to ICEA S-68-516 and ASTM B 29.

h. Solder

(1) Solder used on the shielding braids of any cable shall be 50% Tin / 50% Lead.

(2) Solder used for wiping the lead splice sleeve to the lead sheath of any cable shall be 40 Tin/60 Lead, Class A.

(3) Flux used when soldering conductor connectors or shielding tapes and shielding braids shall be of a non-corrosive and non-acid type.

i. Insulating compound shall be installed in all lead-covered splices and all potheads.

j. Arcproofing Material

For arcproofing materials, refer to Section 16128 of the Specification.

k. Ground Straps

Flexible, tinned copper braid, equivalent to #6 AWG.

l. Special splicing materials and methods shall be as shown on the Contract Drawings.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all wire, cables, equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. Prior to pulling wires and cables, clean raceway systems of all foreign matter and perform all operations necessary so as not to cause damage to wires and cables while pulling.

B. Prior to pulling wires and cables into underground conduit systems, place a feeding tube approved by the Engineer at the entrance end of such systems.

3.03 INSTALLATION

A. Wire and Cable Installation

1. General

a. Keep wires and cables dry at all times.

b. Seal wire and cable ends with watertight end seals if splicing or terminating does not follow at once.

c. Before splicing or terminating wires and cables, make a thorough inspection to determine that water has not entered the wires and cables or that the wires and cables have not been damaged.

d. Use adequate lubrication when installing cables in conduits or raceways. Any pulling compounds shall be compatible with the finish of the wires and cables furnished.

B. Splices and Terminations

1. General

a. All medium voltage wires and cables shall be spliced in each manhole through which they pass.

b. Any splicing or terminating methods other than those required by this Section, for which the components are in accordance with the requirements of this Section, shall be submitted to the Engineer for approval.

c. All cables shall be checked for phase identification before and after terminations have been made. All phase discrepancies shall be corrected.

2. Insulated Wires and Cables

a. Splices and terminations shall be completed by workmen trained and experienced in the type of cable and the voltage class specified in this Section, with not less than 3 years experience in this specialty type of work, and who perform similar splices and terminations on a regular basis.

b. Where required by the Engineer, sample splices shall be demonstrated to the Engineer by each splicer performing the Work of this Section. The sample shall be provided to the Engineer after completion of the demonstration.

c. Terminations using stress-relief cones, which conform to Class 1, IEEE 48 shall be made in accordance with the cable manufacturer's recommendations.

d. Splices shall conform to IEEE 404 and shall:

(1) meet the full electrical and physical integrity of the wire and cable construction, including voltage rating, ampacity, BIL, and type of waterproofing;

(2) conform to the wire and cable manufacturer's requirements and recommendations.

e. For cable where moisture is present, each such cable shall be nitrogen-purged to remove all moisture. The purging procedure shall be submitted to the Engineer for approval.

f. Where splices or terminations are on the Electrical Utility Company (Utility) side of incoming service equipment, the splices or terminations shall be of the type and style approved by the Utility and shall be submitted to the Utility for approval.

3. Grounding Wires and Cables

a. Splices and terminations shall be installed in accordance with the manufacturer's written recommendations.

b. In hazardous or classified locations, splices and terminations shall be solderless, high conductivity, corrosion-resistant, compression type connectors.

c. All underground connections shall be covered with two coats of asphalt base paint.

d. Each splice shall be bonded to ground, using a flexible ground strap, 2 feet long, not less than #6 AWG or equivalent size.

C. Arcproofing

For arcproofing of cables, see Section 16128, of the Specification.

D. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wire ways, and other enclosures, and at all terminal points.

2. The circuit designations shall be as shown on the Contract Drawings. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables that are arcproofed shall be identified outside the applied arcproofing.

E. Field Tests

1. Medium Voltage Shielded Cables

a. After installation and before they are placed in service, run direct current voltage tests in accordance with AEIC CS 6, paragraphs K.2 and K.3, on all shielded cables.

b. A copy of all test reports, together with an outline of the test method used, shall be submitted to the Engineer for review.

2. Ground Wires and Cables

a. Ground wires and cables shall be tested to prove continuity and proper connections to equipment and ground rods.

b. The Contractor shall certify all field testing and shall submit the test results to the Engineer for approval.

F. Factory Tests

1. For quantities as shown on the Contract Drawings, regular dielectric-withstand and insulation-resistance in water tests for wires and cables shall be performed in accordance with UL 44.

2. The following tests for wires and cables shall be performed and certified reports of these tests shall be submitted to the Engineer:

a. Flame tests in accordance with IEEE 383 (were appllicable).

b. Jacket tests in accordance with ICEA 5-68-516.

c. Cable tests in accordance with AEIC CS-6.

3. The test results shall be certified for each shipping reel of wire or cable.

4. Factory inspection and witnessing of tests by the Engineer shall be required for all wires and cables furnished under this Contract. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests.

G. Independent Laboratory Test

1. Unless otherwise shown on the Contract Drawings, submit a 2'-0" sample from 25% of the shipping reels to an independent laboratory for the following tests which shall be performed in accordance with AEIC and ICEA standards.

   a. A.C. Voltage Breakdown Tests

   b. Adhesion of Insulation Shield to Insulation

   c. Volume Resistivity of Conductor Shield to Insulation Shield

   d. Dissection and Dimensional Analysis

   e. Microscopic examination for voids, contaminants, and protrusions

   f. Hot Creep Test to determine state of cure of insulation

   g. Partial Discharge (DC) measurements

   h. Dissipation factor of cable insulation

   i. Impulse breakdown tests.

3.04 ADJUSTMENTS

A. Should the test results reveal any defects, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer in all aspects.

END OF SECTION

SECTION 16121

WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16121A01 Submit Shop Drawings for the installation sequence, pulling tensions and sidewall pressure of all wire and cable pulls, including identification of manhole or pullbox locations with splices.

Catalog Cuts

16121B01 Catalog Cuts
a. Medium voltage cable(s)
b. Ground wire(s)
c. Terminators
d. Splices
e. Pulling devices and end seals

Manufacturer Test Reports

16121F01 Submit certified shop test reports for wires and cables.

Construction and Installation Procedures

16121G01 Submit nitrogen purge procedure for moisture laden wires and cables.

Record Documents

16121M01 Submit field test results for wires and cables, including all test data and methodology.

END OF APPENDIX "A"

DIVISION 16

SECTION 16127

CONTROL/SIGNAL TRANSMISSION MEDIA

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following types of control and signal transmission media:

A. Coaxial Cable

B. Twisted Pair Cable

C. Video - Pair Cable

D. Optical Fiber Cable

E. Optical Fiber Connectors and Couplers

1.02 REFERENCES

The following is a listing of the publications referenced in this section:

	American Society for Testing and Materials (ASTM)
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM E 662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
	Electronics Institute of America (EIA)
EIA FOTP-25	Fiber Optic Test Procedures for Impact Resistance
EIA FOTP-33	Fiber Optic Test Procedures for Maximum Pulling Load
EIA FOTP-41	Fiber Optic Test Procedures for Crush Resistance
EIA FOTP-104	Fiber Optic Test Procedures for Flexibility
EIA TIA-598	Optical Fiber Cable Color Coding Standards
	Insulated Cable Engineering Association (ICEA)
ICEA T-33-655	Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets
	Military Standards
MIL-C-17	Standards for Radio Frequency Coaxial Cables
MIL-C-24643	Electrical Cable and Cord for Shipboard Use, Testing for Low Smoke and Halogens

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code

Naval Engineering Standards

NES 713	Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials

Underwriters Laboratories Inc.

UL 910	Test for Flame - Propagation and Smoke - Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 1666	Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts
UL 1685	Standards for Safety Vertical Tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables

1.03 QUALITY ASSURANCE

A. Wires and cables that have been manufactured more than two (2) years prior to installation shall not be used in the Work of this Contract.

B. Where cables specified in this Section are used to provide signal paths for systems specified in other Sections of these specifications, or for systems shown on Contract Drawings, the Contractor shall obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturer.

C. All optical fiber cable installations, splices and terminations shall be performed by qualified workers with prior experience in installing optical fiber cable and working on optical fiber systems. Work experience shall include the successful installation of at least 3 other optical fiber systems of similar complexity to the Work of this Contract. Qualifications shall include successful completion of training classes covering optical fiber cable installation, termination, splicing and connectorizing.

D. Cable manufacturers shall be regularly engaged in manufacturing control/signal transmission media products of the types, sizes, and characteristics specified in this section and on the Contract Drawings. Cable manufacturers' products shall have been in satisfactory use in similar service for not less than 3 years.

E. The Contractor shall comply with NFPA 70 "National Electric Code" for components and installation.

F. All cable of each kind shall be the product of a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver to the worksite cable properly packaged in factory-fabricated type or wound on NEMA specified type cable reels.

B. The Contractor shall store cable in clean dry space in original containers, protected from weather, theft, vandalism, damaging fumes, construction debris and traffic.

C. The Contractor shall handle cable carefully to avoid braising, puncturing and tearing cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, the Contractor shall provide wires and cables and wire and cable splicing and terminating products of manufacturers as shown on the Contract Drawings.

2.02 Control/ Signal Transmission Media

A. General

1. Locations, types, sizes and numbers of wires and cables are shown on the Contract Drawings.

   Where not indicated, the Contractor shall provide proper wire and cable selection to comply with this section, contract requirements and NFPA 70 Standards, or approved by the Engineer.

2. Unless otherwise shown on the Contract Drawings, solid conductors shall be soft, or annealed copper, conforming to ASTM B 33 (tinned), or ASTM B 3 (uncoated). Unless otherwise specified in this Section or unless otherwise shown on the Contract Drawings, stranded copper conductors shall be concentric stranding conforming to ASTM B 8.

3. Unless otherwise shown on the Contract Drawings, wires and cables that will be installed in riser areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 1666.

4. Unless otherwise shown on the Contract Drawings, wires and cables that will be installed in plenum areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 910.

5. Unless otherwise shown on the Contract Drawings, use the following performance characteristics for wires and cables which will be installed in subway areas, substations, tunnels, etc. where flame retardency, low smoke, low toxicity, zero halogen and good circuit integrity during a fire are required.

   a. Wires shall pass the flame propagatory criteria according to the test method of VW-1.

   b. Cables shall pass the flame propagatory and smoke release criteria according to the test method of UL 1685.

   c. The halogen content of the cable shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

   d. The cable shall comply with ICEA T-33-655 for smoke generation.

e. The toxicity index of the cable shall not exceed 2.0 according to the test method of NES 713.

f. The acid gas content of the cable shall not exceed a maximum of 2.0 percent according to the test method of Mil-C-24643.

6. All wires, cables, splices and terminations, for which there are established UL standards shall bear the UL label.

7. Cable Jacket Labeling

a. The cable jackets shall be labeled using environmental resistant printing in the range of 2 to 4 foot intervals.

b. The label shall indicate:

(1) The length to the end of the cable in feet

(2) The number of wires or optical fibers in the cable

(3) The date of manufacture

(4) The manufacture's name and part number

B. Electronic Cable

1. Single Conductor Coaxial

75-ohm characteristic impedance, solid polyethylene core 97 percent coverage, copper-braid shield, polyethylene jacket; conforming to MIL-C-17.

2. Single Conductor Plenum Coaxial

75-ohm characteristic impedance, solid base copper, central conductor, foamed Teflon dielectric, 100 percent coverage tinned-copper, double-braid shield, Teflon jacket, suitable for installation in air-handling spaces; conforming to MIL-C-17.

3. Direct Burial Coaxial

Single conductor, 75-ohm characteristic impedance, 18 AWG copper clad, steel-center conductor, solid polyethylene dielectric, 34 AWG bare copper-braid outer conductor shield with 95 percent coverage, polyvinyl chloride (PVC) jacket.

4. Aerial Coaxial

Single conductor, 75-ohm characteristic impedance, 18 AWG copper-clad, steel-center conductor, cellular expanded polyethylene dielectric, 34 AWG bare, copper-braid outer conductor shield with 95 percent coverage, ultraviolet-resistant polyvinyl chloride (PVC) jacket.

5. Multiconductor Cable

Quantity and size of conductors shall be as indicated on the Contract Drawings; color coded, low-loss polyvinyl chloride (PVC) insulation; aluminum/mylar shield and 22 AWG tinned-copper drain wire; PVC jacket.

6. Single Twisted Pair

Single-twisted pair, tinned-copper conductors , size of conductors shall be as indicated on the Contract Drawings; color-coded, low-loss polyethylene insulation; unshielded.

7. Multiple Twisted Pair

Quantity of twisted pairs and size of conductors shall be as indicated on the Contract Drawings; tinned-copper conductors; color-coded, low-loss polyethylene insulation; unshielded, polyvinyl chloride (PVC) jacket.

8. Multiple Shielded Twisted Pair

Quantity of twisted pairs and size of conductors shall be as indicated on the Contract Drawings; tinned-copper conductors; color-coded, polyvinyl chloride (PVC) insulation; overall aluminum/polyester shield and 22 AWG tinned-copper drain wire; PVC jacket.

9. Twisted Pair Plenum

Quantity of twisted pairs and size of conductors shall be as indicated on the Contract Drawings; 7-strand, tinned-copper conductors; Teflon insulation; overall aluminum/polyester shield and 22 AWG tinned-copper drain wire; Teflon jacket; suitable for use in air-handling spaces.

10. Video Pair

Balanced pair coaxial cable, 125-ohm characteristic impedance, 16 AWG soft-drawn, bare copper conductors twisted to form pairs, expanded polyethylene core insulation, copper shielding tape, expanded polyester film covering.

C. Optical Fiber Cables

1. Optical fiber cables shall be factory-fabricated, single-channel, low-loss, glass, graded index type. The number of fibers and optical requirements shall be as shown on the Contract Drawings.

2. Unless otherwise shown on the Contract Drawings, the optical fibers shall have a 62.5-micron core diameter, 125-micron cladding diameter and 250 micron (nominal) coat diameter.

3. The optical fibers shall be incorporated in the cable construction using either the loose buffer tube or tight buffer tube method. The optical fibers shall be individually cladded, jacketed, and identified within the buffer tubes.

4. Each fiber shall be distinguishable by means of a continuous color code, continuous numbering, continuous lettering, or a combination of methods. Color coding of optical fiber cables shall be in compliance with EIA/TIA-598.

5. Unless otherwise shown on the Contract Drawings, the optical fibers shall have an attenuation of no more than 3.75 dB/Km at a wavelength of 850 nm, and 1.0 dB/Km at a wavelength of 1300 nm.

6. Unless otherwise shown on the Contract Drawings, the optical fibers shall have a minimum bandwidth of 200 MHz-Km at a wavelength of 850 nm, and a minimum bandwidth of 600 MHz-Km at a wavelength of 1300 nm.

7. Optical fiber cables shall conform to EIA FOTP-25 standard for impact resistance.

8. Optical fiber cables shall conform to EIA FOTP-33 standard for maximum pulling load.

9. Optical fiber cables shall conform to EIA FOTP-41 standard for crush resistance.

10. Optical fiber cables shall conform to EIA FOTP-104 standard for flexibility.

11. Optical fiber cables with PVC jackets are acceptable in indoor, general purpose and riser areas. Optical fiber cables with PVC jackets are not acceptable in indoor plenum areas.

12. Optical fiber cable for outdoor use shall be able to sustain the traffic-induced vibrations at all sites without damage to the physical and optical characteristics of the optical fiber.

13. Optical fiber cable for outdoor use shall be moisture resistant as per EIA FOTP-892 standard.

14. All materials used in the optical fiber cable shall be suitable for use under the following climatic conditions:

    a. Temperatures of -40 to +70 degrees centigrade

    b. Relative humidity of 5% to 100% condensing

15. Optical fiber cable for outdoor use shall be resistant to the following chemicals:

    a. Petroleum products (gasoline, diesel fuel, lubricants, etc.)

    b. Atmospheric nitric acid

    c. Carbon dioxide

    d. Carbon monoxide

    e. Nitrous oxides

    f. Atmospheric sulfuric acid

D. Optical Fiber Connectors

Where shown on the Contract Drawings, Contractor shall install stainless-steel optical fiber cable connectors, capable of terminating optical fiber glass cables. Optical fiber connectors shall have an insertion loss of not greater than 1.0 dB.

2.03 FACTORY TEST

A. Factory Inspection

The Authority shall have the right to inspect the manufacturer's quality control, manufacturing, and testing facilities at any time during the procurement process. Inspection by the Authority will include visual examination of the cables, and all related documentation to ensure that the cables are being fabricated in accordance with the Specifications.

B. Test Plan

Where required by the Contract Drawings, the Contractor shall submit a test plan for each type of cable shown on the Contract Drawings. The test plan shall be approved prior to the start of the factory test. The test plan shall include test schedule, lists of test to be conducted, test equipment to be used, expected test results and test documents produced, and copies of any certified test data to be used in lieu of testing.

C. Factory Test

1. For those tests that are not conducted during factory tests, the Contractor shall submit certification by a recognized independent testing laboratory, showing the complete test results. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests.

2. If factory tests are required by the Engineer, the cables shall not be shipped until after the factory tests have been satisfactorily completed and the cables are approved by the Authority.

3. Factory tests for optical fiber cable shall include, but not necessarily be limited to, the following:

   a. Attenuation of each fiber

   b. Bandwidth of each fiber

   c. OTDR (Optical Time Domain Reflectometer) image of each fiber

4. For all cable the following items shall be tested on a sample basis per the applicable test method:

   a. Consistency of color coding

   b. Cable length

   c. Dimensional tolerances

PART 3: EXECUTION

3.01 PREPARATION

Examine raceways and other elements to receive cable for compliance with installation tolerances and other adverse conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cable as indicated in accordance with NFPA 70 requirements and manufacturer's written instructions. Cable shall be installed in locations as shown on the Contract Drawings by experienced workers in a careful professional manner.

   1. Install transmission media without damaging conductors, shield, or jacket.

   2. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

B. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

   1. Pull cables simultaneously where more than one is being installed in same raceway.

   2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.

   3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.

C. Splicing Of Cable

1. Splicing of optical fiber cable shall be permitted only when the length of the cable run exceeds those of the cable manufacturers pulling distance restrictions.

2. The number of splices per cable shall be kept to a minimum. Splicing shall be permitted only in electrical closets. Splicing of cable runs in roadway or ramp areas shall not be permitted.

3. Splicing of optical fiber cable shall be performed by means of fusion splicing. The Contractor shall submit, for approval, a detailed written procedure, prior to start of work, which shall include:

   a. The number of splices per fiber, and location of each splice, for all optical fiber cables.

   b. The proposed means to support the splice.

   c. Covering or sheathing of splice

4. Splicing shall be performed in a professional manner by experienced workers.

5. Splices shall not have losses exceeding 0.5 dB per splice.

6. All splices shall be enclosed in a splice organizer and then placed in a splice enclosure box to be mounted in the electrical closet. The Contractor shall submit catalog cuts for splice organizers and enclosures to the Engineer for approval.

D. Use splice and tap connectors that are compatible with cable material. All splice locations shall be approved by the Engineer.

E. Bond shields and drain conductors to ground at only one point in each circuit.

F. Connect components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.03 FIELD TESTS

After installation of cable and before energizing, the Contractor shall perform the following field tests:

A. Copper cable procedures

Inspect for physical damage and test cable for continuity and shorts. Use time domain reflectometer with strip chart recording capability and anomaly resolution to within 12 inches (300 mm) in runs up to 1000 feet (300 m) in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

B. Optical fiber cable procedures

Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA Standard ATS, section 7.25. Certify compliance with test parameters and manufacturer's recommendations. The attenuation of each fiber of each cable shall be tested after the cable has been installed. The Authority reserves the right to require:

1. OTDR (Optical Time Domain Reflectometer) tests to be repeated in the field on any fibers that show evidence of physical damage or out-of-specification attenuation. If the field test results indicate that one or more fibers in any segment do not meet the attenuation requirements of this specification, the segment shall be replaced at no cost to the Authority.

C. Operate control/signal systems to demonstrate proper functioning. Replace malfunctioning cable with new materials, and then retest and recommission until satisfactory performance is achieved.

D. All equipment, and personnel, and supervision necessary to conduct the field test shall be provided by the Contractor.

END OF SECTION

SECTION 16127

CONTROL/SIGNAL TRANSMISSION MEDIA

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

16127B01 Catalog cuts for control/signal transmission media.

Samples

16127C01 One (1) foot sample of each type of control/signal transmission media for approval.

16127C02 Sample splice kit materials and installation procedures.

Certificates

16127E01 Cable certificates, acknowledged by the Communication System Manufacturers, certifying that the cables are suitable for the connected equipment as described in Section 1.03 "Quality Assurance".

Manufacturer Test Reports

16127F01 Certified shop test reports for control/signal transmission media.

Manuals, Warrantees/Guarantees

16127I01 Maintenance requirements for cables.

Qualifications

16127K01 Qualification data for manufacturers as per Section 1.03 "Quality Assurance" stating their capabilities and experience. Include list of completed projects and other information specified.

Record Documents

16127M01 Field test reports indicating and interpreting test results.

END OF APPENDIX "A"

16127

DIVISION 16

SECTION 16128

ARCPROOFING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies arcproofing of low and medium voltage cables for new installations as well as existing installations from which asbestos fireproofing has been removed.

1.02 REFERENCES

American Society for Testing and Materials (ASTM)

ASTM D 1000	Test method for Pressure Sensitive Adhesive Coated Tapes used for Electrical and Electronic Applications
ASTM D 1518	Test methods for Thermal Transmittance of Textile Material
ASTM D 2843	Test method for the Density of Smoke from the Burning or Decomposition of Plastics
ASTM D 2863	Test method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastic (Oxygen Index)
OSHA	Occupation Safety and Health Administration

Underwriters Laboratories (UL)

UL 94V-0	Tests for Flammability of Plastic Materials for Part in Devices and Appliances

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Acrproofing shall be furnished, and installed, and reinstalled if required in accordance with this Section and as specified on the Contract Documents.

1.04 QUALITY ASSURANCE

All work shall be performed and completed in a thorough, workmanlike manner and shall follow the best modern practice. All work shall be performed by mechanics skilled in their respective trades.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store material in original packaging in a manner to prevent soiling and physical damage prior to installation.

C. Handle in a manner to prevent physical damage.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 ARCPROOFING MATERIALS

A. Fire Resistant Tape shall be Scotch (3M) No. 77 or approved equal.

B. Glass Cloth Tape shall be Scotch (3M) No. 69 or approved equal.

C. Cable Tags

Stainless steel metal tags, No. 28 gauge and 3/4 inch wide, embossed with letters and numbers 5/16 inch high, fastened to the cable at both ends of tags with nominal 1/16 inch diameter monel metal wire or stainless steel cable ties.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect tape prior to installation. Defective tape shall be discarded.

3.02 INSTALLATION

A. Arcproofing shall be installed as follows:

1. Arcproof all wire and cables operating at greater than 600 volts (line to line).
2. Wires and cables shall be grouped by circuit and arcproofing applied over the group of cables comprising one circuit. Splices shall be arcproofed individually and the taping shall join with and be overlapped by the group taping.
3. Arcproofing shall be applied in two wrappings of half-lapped tape, bound with glass cloth tape applied at the ends of the fire resistant tape and at intervals not to exceed 24 inches along the entire length of the cables. The two wrappings shall be wrapped with opposing-lays.
4. Arcproofing shall be extended into the conduit opening or end bell of the raceway entering a handhole, manhole or box.
5. Arcproofing tape shall be 1 1/2 inch wide where the diameter of the individual cable, or the circumscribed circle for the circuit group, is less than 1 3/4 inches. For larger diameters, the tape shall be 3 inches wide.

B. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, and other enclosures, and at all terminal points.
2. The circuit designations shall be as shown on the Contract Drawings. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables that are arcproofed shall be identified outside of the applied arcproofing.

3.03 ADJUSTMENTS

A. Prior to final inspection, arcproofing that has been disturbed, for any reason, shall be reinstalled as soon as possible.

END OF SECTION

SECTION 16128

ARCPROOFING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Catalog Cuts

16128B01 Submit catalog cuts for Fire Resistant Tape, Glass Cloth Tape and Cable Tags.

END OF APPENDIX "A"

DIVISION 16

SECTION 16133

CONTROL PANELS, ENCLOSURES/CABINETS, AND TERMINAL BOXES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for control panels, electrical enclosures and cabinets.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI Z 55.1	Gray Finishes for Industrial Apparatus and Equipment
	National Electrical Manufacturers Association (NEMA)
NEMA ICS 1	Industrial Control and Systems. General Requirements
NEMA ICS 1.1	Industrial Control and Systems. Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control
NEMA ICS 2	Industrial Control and Systems. Controllers, Contractors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 3	Industrial Control and Systems. Factory Built Assemblies
NEMA ICS	Industrial Control and Systems. Terminal Blocks
NEMA ICS 6	Industrial Control and Systems. Enclosures.
NEMA ICS 9	Industrial Control and Systems. Power Circuit Accessories
NEMA PB 250	Enclosures for Electrical Equipment (1000 Volts maximum)
NEMA Z 535.4	Product Safety Signs and Labels
	National Fire Protection Association (NFPA)
NFPA 70	National Electric Code
	Underwriters Laboratories Inc. (UL)
ANSI/UL 50	Cabinets and Boxes
ANSI/UL 65	Electric Wired Cabinets
ANSI/ UL 486E	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
ANSI/UL 969	Marking and Labeling systems
UL 1059	Electrical Terminal Blocks
ANSI/UL 467	Electrical Grounding and Bonding Equipment
UL 437	Key Locks
ANSI/UL 508	Electric Industrial Control Equipment

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Control Panels, Enclosures/Cabinets and Terminal boxes shall be designed in accordance with applicable standards of ANSI, NEMA, NFPA, and UL.

B. Unless otherwise shown on the Contract Drawings, enclosures/cabinets shall meet the following environmental requirements:

1. Enclosures/Cabinets located in heated areas shall be NEMA Type 1.
2. Enclosures/Cabinets located in unheated areas or in areas subject to dust or oil, shall be NEMA Type 12.
3. Enclosures/Cabinets located in exterior areas or in areas subject to rain, dripping liquid, or hosing shall be NEMA Type 4X, stainless steel.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Control panels, Enclosures/Cabinets and Terminal boxes shall be delivered to the construction site complete. All electrical devices and accessories shall be in place and wired.

B. Control panels, Enclosures/Cabinets, Terminal boxes and accessories shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. Store components and devices in clean and dry space, protected from weather.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces.

1.05 SPARE PARTS AND TOOLS

A. One set of all special tools and wrenches required for assembly or disassembly of the panel or cabinet and the installation of devices shall be furnished.

B. Furnish a list of recommended spare parts for each panel or cabinet. This list shall contain the prices and availability of the spare parts recommended.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 GENERAL

A. List of acceptable manufacturers is shown on contract drawings.

B. All Enclosures/cabinets and equipment, for which there are established UL standards, shall bear the UL label.

C. Location of control panels and enclosures/cabinets and their approximate dimensions shall be as shown on the Contract Drawings.

D. Each control panels, enclosures and cabinets shall be factory assembled, wired, tested and shipped as a single complete unit, with all devices, terminal blocks and internal wiring installed, unless written permission is given by the Engineer to disassemble any components or parts for shipment. Shipped loose components must fit and be ready for immediate installation in the field.

E. Devices installed shall be grouped according to their function. 15% spare mounting space shall be provided for future alterations.

F. All indicating devices, instruments, control switches and indicating lights shall be mounted on the door or front panel. Protection relays, if used, shall be semi-flush type with built-in test facilities wherever possible.

G. No polyvinyl chloride (PVC) materials, insulation or products shall be used.

2.02 CONSTRUCTION FEATURES

A. Interior

1. Control panel interior shall be designed and assembled so that individual devices, terminal blocks and other removable components and wiring may be easily accessible in order to add, remove or replace them without disturbing or removing adjacent units. All devices shall be located on two surfaces only - front and rear. No intermediate swing panels are allowed unless specified on Contract Drawings.

2. The distance between devices and wiring ducts and between terminal blocks and wiring ducts shall be sufficient to install and make clearly visible full wire designation, but not less than 1 inch.

3. All control cables shall be installed in gutters and wiring ducts with removable covers. Filling of gutters and ducts shall not exceed 50 %. Wireways shall have 0.06 square inch area for each external connection terminal point. This area shall be in addition to wireways required for internal wiring.

4. All internal connections to door mounted devices shall be made with extra-flexible (19 strand) wiring bundled together into the cable tie harness with sufficient slack for opening/closing of the door. The bundle shall be enveloped with a helical plastic lacing to prevent wire abrasion. The wire bundle shall be carried between supporting clamps on the door and fixed portion of the enclosure.

5. Devices and terminal blocks shall be mounted on a mounting panel to space them away from rear wall of the enclosure/cabinet.

6. Enclosures/Cabinets with terminal blocks only shall include terminal straps and brackets sized for the particular enclosure/cabinet and designed to space the terminal blocks away from rear wall of the enclosures/cabinets. Straps and brackets shall be Hoffman Engineering Co., Bulletin A-80 or approves equal.

7. Thermostatically controlled space heaters with mechanical guards shall be provided for all outdoor-located enclosures and for indoor enclosures if requested on the *Contract Drawings. Heaters shall be rated 240 volts and operated at 120 volts, each* with an individual circuit breaker of suitable rating. Heaters shall be sized to keep the air inside the cabinet above the dew point.

B. Enclosures and Cabinets

1. Enclosures/Cabinets shall be fabricated of code-gauge, sheet-steel, unless hot-dipped galvanized steel or stainless steel is shown on the Contract Drawings.

2. Enclosures and Cabinets shall have a hinged door unless otherwise indicated on the Contract Drawings. Doors shall be fitted with concealed, continuous, flush piano hinges.

3. Enclosures/Cabinets and trims shall be for surface-mounting, recessed installation or free standing (floor mounting) installation as shown on the Contract Drawings.

4. Trim for recessed or flush-mounted enclosures/cabinets shall consist of a one-piece sheet-steel frame with hinged door, catch and lock. Frame shall extend 3/4-inch beyond each side of the cabinets and shall be set with their backs flush with the finished wall. Rolled lip around all sides of the enclosure shall be provided to exclude liquids and contaminants. Door and body stiffeners shall be provided where required to assure rigid construction.

5. Enclosures/Cabinets for surface mounting shall be provided with the door, hinged directly to enclosures/Cabinets. Door shall be made of one piece of sheet-steel, shall have a 3/4-inch flange around all edges shaped to cover the edge of the box, and shall be provided with a catch and lock. Rolled lip around all sides of the enclosure shall be provided to exclude liquids and contaminants. Door and body stiffeners shall be provided where required to assure rigid construction.

6. Floor mounting (freestanding) enclosures/cabinets shall be fabricated of 10-gauge steel with steel channel base to form a rigid, self-supporting structure. Heavy duty lifting eyes anchor into reinforced top shall be provided.

7. On panels or doors weakened by excessive area punched out for device mounting, reinforcing stiffeners shall be provided for extra rigidity.

8. Enclosures/Cabinets with through wiring shall be provided with side gutters 4 inches wide. Enclosures/Cabinets shall be provided with top and bottom gutters not less than 6 inches wide.

9. All doors shall close against a rabbet placed all around the inside edge of the frame, with a close-fitting joint between the door and frame.

10. Each door shall be furnished with a flush cylinder tumbler lock, with catch, and spring loaded type stainless steel door pull. Doors more than 48 inches high shall be provided with a heavy-duty, three-point latching mechanism with rollers on ends of latch rods for easy door closing. Locks shall be fitted to separate keying for each system. Furnish one key for each cabinet installed and a maximum of 20 keys per system.

11. Fastening door screws or door clamps, where required, shall be stainless steel. Door screws shall be of the captive, tamper proof type.

12. Collar studs shall be provided with internal mounting panel.

13. Provide large removable print pockets, mounted inside of each enclosure/cabinet door.

C. Wiring

1. Wiring shall be sized to the duty required. Control wires shall be # 14 AWG minimum

2. Wiring of all relays, instruments, and other devices shall conform to the arrangement shown on approved wiring diagrams.

3. All control wiring, including all spare contacts of all devices, shall be wired to terminal blocks. Terminals shall be arranged for consecutive connections of conductors which compose a given control circuit or connected device. Number of spare contacts in each device shall be as shown on Contract Drawings.

4. All bus wiring such as 125 V DC, 120 V AC, alarm, etc. shall be insulated wire, run from terminal block to terminal block and not rigid buses.

5. Connections made on terminal blocks and devices shall be by means of insulated locking fork, or insulated ring type crimp terminals. All crimps shall be made with a ratchet type compression tool specifically made for this application to produce optimum mechanical and electrical performance.

6. On devices that do not permit locking fork or ring type terminals, control wiring shall be held by tubular screw-type connectors.

7. Internal wiring shall have no splices, nor shall more than two wires be terminated on one terminal point.

8. Seller is solely responsible for correctness of the internal wiring and proper functioning of the equipment being connected.

D. Terminal blocks

1. Terminal blocks shall be as shown on the Contract Drawings, as follows:

   a. Sliding link disconnect terminal blocks shall be rated 600 volt AC and shall be UL recognized, Powerright Products Inc., series SLD-78-S, or approved equal.

   b. Add on type terminal blocks with screw terminals and clamps, rated 600 volts, and sized to accept a wire range of #22 to #8 AWG, UL recognized and CSA certified.

   c. Solderless tubular terminal blocks add-on type shall be rated 600 volts, and sized to accept a wire range of #22 to #8 AWG, with non-rotating clamping surfaces, UL recognized and CSA certified.

   d. Fuse blocks shall be furnished with 600 volt rated fuses and switch-action, blown fuse indicator, pullers.

   e. Provide terminal block accessories, including fanning strips, jumpers, marking strips and terminal covers.

2. Terminal block housings shall be molded from flame-retardant Lexan, Nylon or Polypropylene and terminal block accessories shall be made of flame-retardant materials. All terminal blocks shall be barrier type.

3. Each terminal block assembly shall be supported after every twelve points.

4. Terminal blocks rated 600 volts, 30 Amps shall be provided for all external connections by purchaser, unless otherwise shown on the Contract Drawings.

5. At least 20% uniformly distributed spare terminals shall be provided.

E. Identification

1. All devices shall be indelibly identified with legend plates inscribed in accordance with approved schematic diagrams and layout drawings.

2. Each Enclosure/Cabinet shall be provided with large engraved nameplate on its front. Nameplate nomenclature shall be according to a schedule approved by the Engineer.

3. Unless otherwise shown on the Contract Drawings, fabricate nameplates from an approved type of lamacoid plastic with letters engraved on the plate in white on black background. Where letter sizes are not shown on the Contract Drawings, use 1/2-inch high letters.

4. Secure nameplates on equipment with brass or stainless steel screws.

F. Accessories

1. Front of board test facilities shall be provided for all instrument and relay current and potential circuits that cannot be individually tested by test devices inherently built into relays or meter. Auxiliary contacts and switches shall be provided where necessary to form part of the test blocks.

2. Interior lighting with switches and receptacles, 120 volts AC, shall be provided if called for on Contract Drawings.

3. A color-coded mimic bus shall be provided if called for on Contract Drawings.

4. Internal copper ground bus, size 1/4 x 1 inch and extended throughout the structure, shall be provided in free standing enclosures/cabinets if called for on Contract Drawings. Ground bus shall be bolted, brazed or welded to the framework, side sheets, etc.

2.03 PAINTING

A. Surfaces to be painted shall be prepared by the removal of all grease, oil, rust, scale or other foreign material and chemically treated to provide a bond between the paint and metal surface preventing the entrance of moisture and the formation of rust under the paint film.

B. A prime coat of zinc chromate paint and two (2) finish coats of enamel paint conforming to ANSI Z 55.1 shall be applied. The gray prime and finish paints shall be a compatible finish system. In public areas the cabinets shall be painted as above, unless otherwise shown on Contract Drawings.

C. Furnish a can of touch up paint for use after equipment is positioned.

D. Stainless steel panels shall not be painted. Galvanized panels shall be painted if shown on the Contract Drawings.

2.04 SHOP TEST

A. Shop tests shall be in accordance with NEMA, ANSI and IEEE specifications, including:

1. High potential and operating tests on power equipment to demonstrate that this equipment will function correctly and in accordance with the intent of the specifications. Check rating of all protective devices (circuit breakers and fuses).
2. Insulation resistance test for each circuit with equipment connected, except those containing electronic components, using a 1000-volt megger. The insulation resistance shall be no less than 25 megohms.
3. Every control circuit continuity test. Use all schematic diagrams.
4. All control devices functional performance test to determine that all devices are wired and function correctly when energized.
5. Simulated operating test for the entire system.

B. Information outlining the test methods and procedures to be followed shall be submitted to the Engineer for approval during the period of shop drawing submission. A copy of test forms to be used shall be furnished at the time.

C. The Engineer shall be permitted to inspect any equipment, material or work to be furnished under this specification and shall have the right to reject any parts considered defective, unsuitable for the purposes or not in accordance with these specifications. Free entry shall be permitted to the Engineer at all times and to all parts of the works engaged in the manufacturing of this equipment.

D. The Engineer shall be notified in writing at least two weeks before testing. This notification shall list all units to be tested. The Engineer reserves the right to require additional testing or to waive factory inspection or witnessing of tests. The Engineer will advise the Contractor which tests will be witnessed and which will be waived.

E. Facilities for any reasonable tests that may be considered necessary in connection with any inspection shall be furnished free of charge. The shop shall provide equipment, instruments, cables, tools and personnel required and shall bear all expenses incidental to the foregoing tests, including replacement of damaged parts and material.

F. During the witnessing of tests, all original test data shall be initiated by the Engineer, and at the conclusion of the tests he shall be furnished with one copy of all original test data. If any data was modified, the Engineer shall be apprised and such modification shall be subject to the approval of the Engineer.

G. The accuracy of the calibration of all instruments to be employed during the tests shall be ascertained and recorded at the beginning of the tests. All readings shall be directed and visible to the Engineer.

H. Five (5) certified copies of all test results shall be furnished to the Engineer. Certification shall be by a Professional Engineer, licensed in the State in which tests were performed and so stamped.

I. Release of equipment shall not relieve the Contractor of the responsibility of furnishing equipment conforming to all specification requirements.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documentation.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory Work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 PREPARATION

A. Install any channels, angles or other supports that are required to support or mount the control panels and enclosures/cabinets.

B. Use supports and fasteners as specified in the Section of the Specifications entitled "SUPPORTING DEVICES" or as shown on the Contract Drawings.

3.03 INSTALLATION

A. Surface and flush mounted enclosures/cabinets shall be installed with tops 6 feet-6 inches above the floor, unless otherwise shown on the Contract Drawings.

B. Control panels and enclosures/cabinet shall be installed true and plumb on supporting struts and shall not be mounted directly on concrete, concrete block walls, or any other walls subject to moisture. Leave a minimum gap of 1/2 inch between the back of the enclosure/cabinet and the wall, using stainless steel hardware.

C. Where mounting directly on the wall is unavoidable the back of the enclosure shall be painted with two coats, minimum, of a bituminous paint.

D. Cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures/cabinets, cable ducts or gutters. Minimum bending radii as recommended by cable manufacturers shall not be reduced.

E. After conduits and cables are installed, the enclosures/cabinets shall be inspected for foreign materials and shall be vacuumed clean. Prior to energization, the panels shall be tested as described below.

F. A new set of as-built drawings, neatly bound together in plastic covers, shall be placed in the print pocket of each enclosure/cabinet.

3.04 FIELD TESTS

A. Visually inspect each device in the panel and operate manually.

B. Check all connections for tightness.

C. Check rating of all protective devices (circuit breakers and fuses). To each pole of the circuit breakers apply current 3 times its rating, recording currents and breaker trip times. Apply rapidly increasing currents and record the value that consistently causes instantaneous tripping of the breaker. Compare these recorded times with manufacturer's time current curves.

D. Perform each panel control wiring tests to determine that all devices are function correctly when energized and in accordance with the intent of the Contract Drawings and Specifications.

E. Perform control system functional test. This test shall include step by step procedure to determine that entire control system (this control panel could be just part of it) operate properly.

F. All discrepancies found by the contractor shall be brought to the attention of the Engineer.

G. All testing shall be performed in the presence of and as directed by the Engineer. The Contractor shall notify the Engineer when the equipment is installed and ready for testing.

END OF SECTION

SECTION 16133

CONTROL PANELS, ENCLOSURES/CABINETS, AND TERMINAL BOXES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16133A01 Shop drawings for each enclosure/cabinet shall include:

1. Job name
2. Item number
3. Quantity of each enclosure/cabinet configuration
4. Nameplate schedule in accordance with design drawings
5. Complete assembly drawings including plan, elevation and section views with dimensions. Show dimensioned location of all devices, terminal blocks, accessories and details for purchaser cable support. Indicate conduit entrance areas and mounting details.
6. Cabinet/Enclosure construction details, floor plan and channel base detail drawings
7. Specification for enclosure/cabinet mechanical and electrical parts, and assemblies.
8. Wiring interconnection and schematic diagrams as follows:
   a. The elementary diagrams supplied by panel vendor shall contain
      (1) Each device designation corresponding to panel layout drawing and wiring diagrams
      (2) All device terminal numbers corresponding to device vendor information
      (3) Contact development diagrams of all control, selector, and transfer switches, protection and auxiliary relays, pushbuttons, etc. Indicate connections to control panel terminal blocks
      (4) Contact diagrams for all alarm and indication circuits. Indicate connections to control panel terminal blocks
   b. Control panel internal connection wiring diagram shall contain
      (1) Each device designation corresponding to panel layout drawing and elementary diagrams. All device terminals shall be identified identical to device vendor drawing and arranged in correct physical relationship.
      (2) Sufficient information at each wire termination to locate the other termination without recourse to routing sheets, supplementary tabulations, or any other document.
      (3) Terminal strips numbered sequentially from top to bottom and left to right. Show terminals requiring external connections. The terminal strips shall be shown on drawings spaced at least 4 inches apart, so as to permit purchaser's external wiring to be shown on the same drawings.
   c. External connection diagram between the control panel and the equipment connected to it.
9. Bill of materials: Components shall be identified by manufacturer's catalog number, technical characteristics and settings required for the installation. Bill of materials shall

correlate components to panel layout drawing and diagrams.

Catalog Cuts

16133B01 Catalog cuts
a. Enclosures
b. Cabinets
c. Terminal blocks
d. All factory or field mounted devices and equipment shown on the control panel or Enclosure/Cabinet drawings.

Schedules

16133J01 Schedules
a. Nameplate nomenclature
b. Terminal block designations

Record Documents

16133M01 As-built documentation.

END OF APPENDIX "A"

DIVISION 16

SECTION 16135

BOXES AND FITTINGS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for electrical boxes and fittings.

B. Types of electrical boxes and fittings specified in this Section are:

1. Outlet Boxes
2. Device Boxes
3. Pull Boxes
4. Junction Boxes
5. Conduit Bodies
6. Fittings

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA OS1	Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA OS2	Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 50	Cabinets and Boxes
UL 514A	Metallic Outlet Boxes
UL 514B	Fittings for Conduit and Outlet Boxes
UL 514C	Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers
UL 886	Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.03 QUALITY ASSURANCE

Boxes and fittings, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years. A list of acceptable manufacturers is shown on Contract Drawing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.05 SUBMITTALS

"Submittal Requirements" shall be in accordance with APPENDIX A.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Locations, types and sizes of boxes and fittings are shown on the Contract Drawings.

2. Boxes and fittings shall be metallic, unless otherwise shown on the Contract Drawings, and shall conform to NEMA 0S1, NEMA 250, UL 50, UL 514A, UL 514B, and NFPA 70.

3. Nonmetallic boxes and fittings, shown on the Contract Drawings, shall conform to NEMA 0S2, NEMA 250, UL 50, UL 514C, and NFPA 70.

4. Boxes and fittings to be located in hazardous (classified) areas, as shown by "area plans" on the Contract Drawings shall conform to UL 886 & NFPA 70.

5. All electrical materials and equipment, for which there are established UL standards, shall bear the UL label.

6. Where the sizes or dimensions of a box are not shown on the Contract Drawings, all boxes, whether for use on power, communications, signaling, control, telephone, or other purposes, shall be sized as follows:

a. In straight pulls, the length of the box shall not be less than 8 times the trade diameter (nominal inside diameter) of the largest raceway.

b. Where angle or "U" pulls are made, the distance between each raceway entry inside the box and the opposite wall of the box shall not be less than 6 times the trade diameter of the largest raceway. The distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in any row on the same wall of the box. The distance between raceway entries enclosing the same conductor shall not be less than 6 times the trade diameter of the larger raceway.

c. Where a conduit entry is in the wall of a box opposite a removable cover, the minimum distance between the entry and the cover shall be as follows:

Conduit Size	Distance Between Entry and Cover
Up to 1-1/4"	4"
1-1/4" and 1-1/2"	6"
2" and 2-1/2"	8"
3" and larger	12"

d. The minimum depth of a box shall be not less than two times the trade diameter of the conduit entries in a single row and not less than 1-1/2 times the sum of the trade diameter of the largest raceway in each row for multiple rows.

7. Weatherproof cast boxes shall be used for exterior or damp locations. Weatherproof boxes shall be hot-dipped galvanized cast-steel or cast-aluminum. Cast boxes shall be threaded conduit entrance type provided with mounting lugs. Materials shall match the type of conduit i.e., galvanized steel or aluminum, used in the conduit run.

8. Covers for boxes located in public spaces or where shown on the Contract Drawings shall be furnished with tamper-resistant hardware.

9. Cover plates for outlet boxes are specified in the Section 16140 entitled "WIRING DEVICES".

B. Interior Outlet and Device Boxes

1. Provide galvanized, flat-rolled, sheet-steel interior outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct boxes with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

2. Outlet boxes shall be of proper sizes and shapes for conduits and wires entering them, and equipped with plaster ring or cover as necessary for the wiring devices to be installed.

3. Boxes for switches and receptacles shall be 4-inch square, minimum 2 1/8-inch deep, for up to two devices; solid, ganged boxes for over two devices; and installed so that device covers shall be tight and plumb with wall finish.

4. Provide suitable barrier in boxes where two or more 277-volt switches are to be installed, to isolate each on its own phase.

5. Boxes for lighting fixture installation shall be 4-inch square, minimum 2 1/8-inch deep, and provided with 3/8-inch studs.

6. Boxes to be installed in ceilings, plenums, or spaces used for supply or return of environmental air shall be UL listed for such use, without holes, openings or penetrations, and complete with gasketed cover plates.

7. Provide all sheet-steel boxes with suitable knockouts.

C. Exterior Outlet and Device Boxes

1. Provide corrosion-resistant, cast metal, weatherproof outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation.

2. For outlet boxes to be installed flush or recessed in exterior walls, provide galvanized, sheet-steel boxes, with suitable depth and tile, plaster or masonry rings for the wall construction.

3. Provide cast-metal faceplates with spring-hinged, waterproof caps suitably configured for each application, including faceplate gaskets and stainless steel or brass screws or fasteners. Faceplate material shall match the type of box i.e., galvanized steel or aluminum.

D. Junction and Pull Boxes

1. General

a. Unless otherwise shown on the Contract Drawings, provide galvanized, code-gauge, sheet-steel junction and pull boxes and covers for interior locations and cast-metal boxes and covers for exterior locations of types, shapes and sizes to suit each respective location and installation, and equipped with stainless steel hinges, nuts, bolts, screws and washers.

b. Junction or pull boxes having any dimension larger than 36 inches shall contain racks or supports for all cables or conductors.

c. Provide pull boxes with suitable insulating barriers where shown on the Contract Drawings or required by code. Vertical-offset pull boxes shall contain cable supports at turns to prevent cables from resting on corners.

d. Where shown on the Contract Drawings, provide boxes with provisions for padlocking.

e. Special boxes shall be as shown on the Contract Drawings.

f. Where shown on the Contract Drawings, catches or vault handles shall be lockable. Locks shall be keyed alike for the same service, such as power, communications, signal or telephone. Each service type shall be keyed differently.

g. All covers in exposed exterior locations, or other areas as shown on the Contract Drawings, shall be gasketed.

h. For covers heavier than 20 pounds or more than 24 inches in any dimension, provide two replaceable studs, located on each side of the box flange, to support the cover during installation.

i. Boxes containing, or designated for, conductors operating at greater than 600 volts (phase-to-phase) shall be constructed of minimum 12-gauge steel.

2. Interior Junction and Pull Boxes

a. Finished Areas

(1) Junction and pull boxes, located in finished areas and having any dimension larger than 12 inches, shall be furnished with flush-mounting, lockable, hinged covers, similar to adjacent panelboard cabinets. Locks shall be keyed alike for the same service, such as power, communications, signal or telephone. Each service type shall be keyed differently. Hinged covers shall contain catches to keep covers closed. Covers having any dimension larger than 36 inches and all multiple-section doors shall contain 3-point vault handles. Covers shall be furnished shop-primed for field painting, and shall be finished with a color as selected by the Engineer.

(2) Boxes having any cover dimension 12 inches or less shall be furnished with flush-mounting, screw-on covers, unless otherwise shown on the Contract Drawings.

b. Unfinished Areas

Junction and pull boxes, located in electrical or telephone closets or rooms, in mechanical equipment rooms, in areas above hung or accessible ceilings or in areas shown on the Contract Drawings as "unfinished," shall be furnished with screw-on covers for boxes having any cover dimension 24 inches or less, and with either single or multiple-section hinged covers for boxes having any cover dimension larger than 24 inches..

3. Exterior Junction and Pull Boxes

a. Junction and pull boxes, located in sidewalks, decks and in areas shown on the Contract Drawings as "finished", shall be furnished with flush-mounting, screw-on covers.

(1) Boxes having any cover dimension 24 inches or less shall be cast-steel. Boxes shall be furnished with asphaltic paint finish on surfaces to be embedded in earth or concrete.

(2) Covers having any dimension larger than 24 inches shall be cast-steel "sidewalk" frames and covers, suitable for installation on a concrete box or handhole.

b. Unfinished Areas

Junction and pull boxes, located in areas shown on the Contract Drawings as "unfinished", shall be furnished with screw-on covers for boxes having any cover dimension 24 inches or less, and with hinged, bolt-on covers for boxes having any cover dimension larger than 24 inches.

E. Floor Boxes

Provide cast-steel, waterproof, adjustable floor boxes with threaded-conduit entrance hubs, and vertical adjusting rings, gaskets, brass floor plates and flush, screw-on covers. All unused conduit openings shall be closed with appropriate plugs.

F. Conduit Bodies

Provide galvanized, cast-metal, conduit bodies, of types, shapes and sizes to suit each respective location and installation; construct with threaded-conduit entrance hubs, removable covers, and stainless steel or brass screws.

G. Bushings, Locknuts and Knockout Closures

Provide corrosion-resistant knockout closures and conduit locknuts, and insulated, malleable-iron, conduit bushings and offset connectors, of types and sizes to suit each respective use and installation.

H. Supporting Devices

Provide inserts, expansion shield lugs, bolts with nuts and washers, shims or any other type of fastening devices required to secure boxes, in accordance with the Section 16190 entitled "SUPPORTING DEVICES". Unless otherwise shown on the Contract Drawings, all fasteners shall be hot-dipped galvanized and of sizes and types recommended by the equipment manufacturer and as approved by the Engineer.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install boxes and conduit bodies at the locations shown on the Contract Drawings and as required by NFPA 70 at any other location where they are required to facilitate the pulling, supporting or connection of wires and cables.

B. Securely mount all boxes in a manner approved by the Engineer and support the boxes independently of conduits entering them.

C. Install boxes and conduit bodies in classified (hazardous) locations in accordance with their listing or label requirements. Conduit seal fittings shall be packed and filled only after proper operation of equipment and systems has been demonstrated and approved by the Engineer.

D. Paint exteriors of boxes exposed in mechanical equipment rooms or in electrical rooms or closets or spaces shown as "unfinished" on the Contract Drawings, and the exteriors of boxes installed above hung or accessible ceilings, as follows:

1. Emergency: Orange
2. Fire Alarm: Red
3. High Voltage: Red with 1-inch, white block letters reading "HIGH VOLTAGE" on each exposed face and cover.

E. All installations shall conform to NFPA 70.

F. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.

2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

END OF SECTION

SECTION 16135

BOXES AND FITTINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16135A01 Shop drawings
a. Special boxes
b. Boxes lager than 12 inches
c. Ancillary equipment if shown on Contract Drawings

Catalog Cuts

16135B01 All boxes and fittings

END OF APPENDIX "A"

DIVISION 16

SECTION 16140

WIRING DEVICES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wiring devices.

1.02 REFERENCES

The wiring devices specified in this Section shall be constructed, installed and tested in accordance with requirements of the following publications:

	Federal Specifications
W-C-596	Electrical Power Connector, plug, Receptacle and Cable
W-S-896	Outlet Toggle and Lock, Flush Mounted Switches
	Institute of Electrical and Electronic Engineers (IEEE)
IEEE 241	Electric Power Systems in Commercial Buildings
	National Electrical Manufacturers Association (NEMA)
NEMA WD 1	General Requirements for Wiring Devices
NEMA WD 6	Wiring Devices - Dimensional Requirement
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 20	General Use Snap Switches
UL 498	Electrical Attachment Plugs and Receptacles
UL 917	Clock-Operated Switches
UL 943	Ground Fault Circuit Interrupters
UL 1054	Special - Use Switches

1.03 QUALITY ASSURANCE

Wiring devices, of types and ratings required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store materials in clean, dry space and protect them from weather.

C. Handle in manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, provide wiring devices of the acceptable manufacturers as shown on Contract Drawings.

B. All devices for wall system outlets shall be furnished by one manufacturer.

C. All device plates shall be furnished by one manufacturer.

2.02 CONSTRUCTION FEATURES

A. General

1. All wiring devices shall be heavy-duty, specification grade, conforming to the NEMA configurations and requirements of NEMA WD 1 and UL 498, including the requirements for pressure-blade contacts. NEMA configurations shall be as shown on the Contract Drawings and shall match the requirements of the connected appliances.

2. Locations, types and sizes of wiring devices shall be as shown on the Contract Drawings.

3. All devices shall be one gang wide, except as required for devices rated greater than 20 Amp.

4. All devices shall be terminated with screw terminals or screw-driven pressure clamps. Patented spring or torsion pressure clamps shall not be used.

5. All electrical materials and equipment, for which there are established UL standards, shall bear the UL label.

B. Switches

Switches shall be silent operating type, 20 Amp, 120 - 127 Volts AC, T-rated, flush mounted, conforming to requirements of Federal Specification W-S-896 and UL 20, 917 and 1054. Single-pole or double-pole, and 3-way or 4-way devices shall be as shown on Contract Drawings.

C. Receptacles

1. Duplex convenience receptacles shall be 125 V, straight blade, 2-pole, 3-wire grounding type units with break-off terminal ties for two-circuits application. Receptacles shall be 15 Amp or 20 Amp as shown on Contract Drawings.

2. Single receptacles shall be 20 Amp, 125 V, straight blade, 2-pole, 3-wire, grounding type units.

3. Clock outlets shall be single recessed receptacles rated 15 Amp, 125 V, 2-pole, 3-wire grounding type with a combination plate cover and clock hanger bracket.

4. Floor service receptacle outlets shall be furnished with 20A, 125V, 2-pole 3-wire grounding type duplex receptacle. Were shown on contract drawings receptacle shall be flush mounted in floor box or installed in metallic above-floor service fitting.

5. Factory assembled "poke through" assembly device shall be furnished with 20A, 125v, 2-pole, 3-wire grounding receptacle and capable of maintaining floor fire rating of 3 hours.

6. Ground fault circuit interrupter receptacle shall be 20A, 125V, 60 Hz heavy duty grounding type duplex receptacle with ground fault circuit interrupter with solid-state ground fault sensing device having 5 (±1) milliampere ground-fault trip level and shall be "feed through" ready, for protecting downstream receptacles on a single circuit; suitable for installation in a 2-1/2" deep outlet box without adapter.

7. Special purpose receptacles as shown on Contract Drawings shall conform to requirements of NEMA WD 6.

D. Device Plates

1. All device plates shall be 0.04" thick minimum with struck-up beveled edges and free of sharp corners and burrs. All device plates shall be one-piece sectional plates shall not be used.

2. Unless otherwise shown on Contract Drawings, all device plates for wall outlets shall be satin finish anodized aluminum.

3. Device plates for wall telephone outlets shall contain a bushed hole.

4. Device plates for exposed work shall be stamped steel.

E. Color Selection

Wiring devices shall be available in standard white, ivory, gray, brown and black. The Engineer will select different colors for various areas and for different devices. No wiring device shall be ordered or installed until the engineer's final color selections have been made.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install wiring devices in accordance with manufacturer's installation procedures and applicable requirements of NFPA 70 and IEEE 241.

B. In areas where exposed conduit is used, receptacles and switches shall be surface mounted as shown on the Contract Drawings.

C. Receptacles and switches located in finished areas, where concealed conduits are used shall be flush-mounted and provided with approved cover plates, installed level and plumb, with all four corners and edges in contact with finish surface.

3.02 FIELD TESTS

Prior to energizing circuitry, test wiring for electrical continuity and short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements of this Specification.

3.03 PROTECTION

After receptacles and wall plates have been installed, exercise care in use of convenience outlets. Prior to final inspection, replace devices that have been damaged.

END OF SECTION

SECTION 16140

WIRING DEVICES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16140A01 Shop drawings
a. Installation details for surface mounted receptacles and switches
b. Installation details for "poke-through" assemblies
c. Installation details for floor service receptacles

Catalog Cuts

16140B01 Catalog cuts
a. Receptacles
b. Switches
c. Wallplates
d. Ground fault circuit interrupter receptacles
e. Poke-through assembly devices

END OF APPENDIX "A"

DIVISION 16

SECTION 16150

MOTOR POWER AND CONTROL WIRING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the furnishing, installation, connection and testing of motor power and control wiring.

A. Motor Power and Control Wiring

Furnish and install all conduits, wires and accessories, and make final connections to all motors, motor starters, motor control centers, control devices and appurtenances furnished under other Sections of the Specifications.

B. Motor Starters, Motor Control Centers, and Control Devices

Install motor starters, motor control centers, control devices (except as specified in the following sentence) and appurtenances furnished under other Sections of the Specifications. Control devices having piping connections shall be installed under other Sections, but shall be wired under this Section.

C. Wiring diagrams and Equipment Installation Schedules

Wiring diagrams and equipment installation schedules or functional and/or operational requirements are shown on the Contract Drawings. Coordinate and supplement the wiring diagrams and schedules with any additional functional or operational requirements specified in other Sections of the Specifications. In the event of a conflict between the wiring diagrams and schedules and the functional and operational requirements, the latter shall govern.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA ICS 2	Industrial Control and Systems. Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	Industrial Control and Systems, Terminal Blocks
	National Fire Protection Association (NFPA)
NFPA 70	National Electric Code

Underwriters Laboratories Inc. (UL)

ANSI/UL 65	Electric Wired Cabinets
ANSI/UL 486E	Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use With Copper Conductors
ANSI/UL 969	Marking and Labeling systems
UL 1059	Electrical Terminal Blocks
ANSI/UL 467	Electrical Grounding and Bonding Equipment
ANSI/UL 508	Electric Industrial Control Equipment

1.03 QUALITY ASSURANCE

Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 SUBMITTALS

See Appendix "A" for Submittal Requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Provide all conduits, wires, and accessories as shown on the Contract Drawings and as required to perform the Work.

B. Provide all conduits and wires in accordance with the Sections of the Specifications entitled "RACEWAYS" and "WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS).

C. Provide angle iron supports, brackets or hangers for mounting starters, control panels and control devices in accordance with the Section of the Specifications entitled "SUPPORTING DEVICES".

D. All fuses and circuit breakers provided under this Section shall be of the ratings and types as shown on the Contract Drawings or, if not shown on the Contract Drawings, shall be as recommended by equipment manufacturers.

E. All motor control equipment shall be manufactured in compliance with NEMA ICS 2, NEMA ISC 4, ANSI/UL 65, ANSI/UL486E, ANSI/UL486A, ANSI/UL 969, ANSI/UL 467, ANSI/UL 508 and UL 1059.

PART 3. EXECUTION

3.01 EXAMINATION

A. Prior to making electrical connections, check all electrical equipment furnished under other Sections of the Specifications for the specified voltages and directions of rotation.

B. Prior to energizing motors, verify the specified overload rating of all heater elements and relay settings, furnished with the motor starters under other Sections of the Specifications, so that, in cases, the proper running protection will be provided for the motors. Should the overload ratings not be correct, notify the Engineer.

3.02 INSTALLATION

A. Install all motor starters, motor control centers, control devices, conduits, wires and accessories in accordance with the requirements of NFPA 70 and the manufacturers' installation procedures. Make final connections in accordance with approved shop drawings.

B. Install all conduits, wires, accessories and supports in accordance with the requirements of Sections specified in 2.01 B and C.

3.03 FIELD TESTS

A. Perform tests, in presence of the Engineer, to demonstrate the following and give the Engineer 24 hours advance notice of tests.

1. That each control device and its related motor starter operates properly.
2. That each overload protective and safety device functions properly.

B. Tests shall be performed in accordance with the equipment manufacturers' start-up and field test instructions and made jointly with all affected trades.

C. Should the tests reveal any defects, promptly correct such defects and rerun the tests until the entire installation is satisfactory in all respects.

END OF SECTION

SECTION 16150

MOTOR POWER AND CONTROL WIRING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16150A01 Shop drawings shall include:
a. Job name
b. Item number
c. Specification for electrical parts, and assemblies.
d. Wiring interconnection and schematic diagrams as follows:
i. The elementary diagrams supplied by equipment vendor shall contain
1. Each device designation corresponding to equipment layout drawing and wiring diagrams
2. All device terminal numbers corresponding to device vendor information
3. Contact development diagrams of all control, selector, and transfer switches, protection and auxiliary relays, pushbuttons, etc. Indicate connections to terminal blocks
4. Contact diagrams for all alarm and indication circuits. Indicate connections to control panel terminal blocks
ii. Connection wiring diagram shall contain
1. Each device designation corresponding to equipment layout drawing and elementary diagrams. All device terminals shall be identified identical to device vendor drawing and arranged in correct physical relationship.
2. Sufficient information at each wire termination to locate the other termination without recourse to routing sheets, supplementary tabulations, or any other document.
3. Terminal strips numbered sequentially from top to bottom and left to right. Show terminals requiring external connections. The terminal strips shall be shown on drawings spaced at least 4 inches apart, so as to permit purchaser's external wiring to be shown on the same drawings.
iii. External connection diagram between the equipment and devices connected to it.

Catalog Cuts

16150B01 Catalog cuts
a. Protection and control devices
b. Terminal blocks
c. All factory or field mounted devices and equipment shown on Equipment Drawings

Product Data

16150D01 Bill of materials. Components shall be identified by manufacturer's catalog number, technical characteristics and settings required for the installation. Bill of materials shall correlate components to equipment layout drawing and diagrams.

Schedules

16150J01 Schedules
a. Terminal block designations

Record Documents

16150M01 As-built documentation

END OF APPENDIX "A"

DIVISION 16

SECTION 16190

SUPPORTING DEVICES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for hangers and supports, sleeves and fasteners used to support electrical raceways and equipment, except as specified in B below.

B. Supporting devices, furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Sections of the Specifications.

1.02 REFERENCE

The supporting devices, specified in this Section shall be constructed, installed and tested in accordance with requirements of the following publications:

	American Institute of Steel Construction Inc. (AISC)
AISC	Manual of Steel Construction
	American Iron and Steel Institute (AISI)
AISI	Specifications for the Design of Cold-Formed Steel Structural Members
	American Society for Testing and Materials (ASTM)
ASTM A 36	Structural Steel
	American Welding Society (AWS)
AWS D1.1	Structural Welding Code, Steel
	National Electrical Contractors Association (NECA)
NECA 5055	Standard of Installation
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code

1.03 QUALITY ASSURANCE

Supporting devices, of types and sizes required, shall have been satisfactory used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up damage to finishes to match adjacent surfaces, including re-coating of galvanized or plated surfaces where damaged, cut or drilled.

1.05 SUBMITTALS

See Appendix "A" For Submittal Requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide supporting devices of the acceptable manufacturers as shown on Contract Drawings.

2.02 HANGERS AND SUPPORTS

A. General

1. Unless otherwise shown on the Contract Drawings, provide hangers and supports as specified below.

2. Where more than one type of hanger or support is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

3. Hangers and supports, for which there are established Underwriters Laboratories Inc. (UL) standards, shall bear the UL label.

B. Raceway Support

1. Clevis Hangers

For supporting horizontal conduit; galvanized steel; with hole for treaded steel rod.

2. Riser Clamps

For supporting vertical conduits; galvanized steel; with two or three bolts and nuts, and 4-inch ears.

3. Reducing Couplings

Steel rod reducing coupling; size as required; galvanized or plated steel

4. C-Clamps

Black malleable iron or galvanized or plated steel; with hole for threaded rod.

5. I-Beam Clamps

Galvanized or plated steel, 1-1/4-inch x 3/16-inch stock; 3/8-inch cross bolt; 2-inch flange width

6. Right Angle or Parallel beam Clamps

Galvanized steel clamps for supporting or fastening conduit up to 2-inch trade size

7. One-Hole Conduit Straps

For supporting up to 1-inch conduit or electrical metallic tubing (EMT); galvanized steel

8. Two-Hole Conduit straps

For supporting conduit or EMT larger than 1-inch galvanized steel; 3/4" strap width.

9. Hexagon Nuts: galvanized steel

10. Round Steel Rod: galvanized or plated steel; threaded

11. Trapeze Hangers: Same as Specified in 2.02 C below

12. The following types of hangers and supports shall not be used:

    a. Perforated metal strapping;

    b. Slotted, perforated angles;

    c. Spring pressure or torsion clips, hangers or supports.

C. Equipment Supports

1. U-channel strut system shall be 12-gauge, hot-dipped galvanized steel. Provide with drilled or slotted holes as required for the application and with the following fittings which mate and match with U-channel:

    a. Fixture hangers

    b. Channel hangers

    c. End caps

    d. Beam clamps

    e. Wiring stud.

    f. Thin wall conduit clamps

    g. Rigid conduit clamps

    h. Conduit hangers

    i. U-bolts

D. Supporting Steel Sections and Channels

Supporting steel sections and channels shall be fabricated of ASTM A 36 steel in accordance with the appropriate requirements of the AISC, AISI, and AWS publications specified in 1.02, and shall be hot-dipped galvanized after fabrication.

E. Cable Supports

1. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers. Assembly shall include body of galvanized malleable iron with insulating wedging plug.

2. Provide cable supports for armored type electrical cables in risers. Assembly shall include body and pressure plates of galvanized steel.

2.03 SLEEVES AND SEALS

A. General

1. Unless otherwise shown on the Contract Drawings, provide sleeves and seals as specified below.

2. Where more than one type of sleeve or seal is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

3. Sleeves and seals, for which there are established, UL standard, shall bear the UL label.

B. Pipe Sleeves

1. Provide pipe sleeves for conduits penetrating concrete or masonry floor and walls, as follows:

   a. Steel Pipe

      Fabricate from schedule 40, galvanized steel pipe; remove burrs.

   b. Iron Pipe

      Fabricate from cast iron or ductile iron pipe; remove burrs.

   c. Plastic Pipe

      Fabricate from either fiberglass or Schedule 40, PVC plastic pipe; remove burrs. Fiberglass sleeves may be utilized for interior or exterior usages, but PVC sleeves shall be utilized for exterior usage only.

2. Sleeves shall have a minimum inside diameter as shown below, based on the installed raceway diameter.

Raceway Diameter (inches)	Sleeve Inside Diameter (inches)
1 or less	2
1-1/4 to 2	3
2-1/2 to 3	4
3-1/2 to 4	5
5	6
6	7

3. Where a sleeve encloses only one conductor, phase or polarity, or a ground wire or cable, the sleeve shall be non-ferrous.

C. Interlocking Modular Seals

Provide interlocking modular type seals for conduit access located in exterior foundation and pit walls. The seals shall be multi-link, stainless steel bolted connection, high-temperature fittings.

D. Sealing Bushings

Provide sealing bushings for conduit access core-drilled through foundation walls or floors. The bushings shall be molded, one-piece neoprene sealing rings with PVC coated steel or uncoated aluminum pressure plates, stainless steel hex socket head cap screws and flat washers.

E. Fire Seals

Provide UL listed, 3 hour rating, silicone based foam, fire resistive, waterproof joint sealing system to prevent the passage of hot gases and fire.

F. Wall and Floor Seals

Provide watertight and pressure-tight wall and floor seals suitable for sealing around conduit passing through exterior concrete floors and walls. Assembly shall include steel sleeves, galvanized malleable iron body, neoprene sealing grommets and rings, metal pressure rings, membrane clamp were required by foundation design and pressure clamps with type 316 stainless steel hex head cap screws. Seal sizes shall be maximum published size for conduit to be installed therein.

2.04 FASTENERS

A. General

1. Unless otherwise shown on the Contract Drawings, provide fasteners as specified below.
2. Where more than one type of fasteners is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

B. Toggle Bolts

Toggle bolts shall be spring head, galvanized or plated steel, 1/4-inch to 1/2-inch sizes, length as required.

C. Expansion Anchors

Expansion anchors shall be metallic expansion anchors or shields, including drop-in anchors, wedge and sleeve anchors, and two-piece and three-piece shields for lag screws or machine screws or bolts.

D. Powder activated Fasteners

Powder activated fasteners shall be steel, pin or stud type, selected for proper length and penetration for the equipment, clamp or strap to be installed, and the base material.

E. Bolts, Nuts, Lockwashers and Washers

1. All hardware shall be galvanized or plated steel, unless otherwise shown on the Contract Drawings.
2. Bolts and nuts, 1/4-inch trade size and larger, shall be hex head or hex socket type, standard American sizes.
3. Lockwashers shall match the finish of the furnished bolts and nuts, and generally be installed one-per-bolt, at the nut end of the assembly.

4. Washers shall be standard or fender type, as required, and sized to match the installed bolts or screws.

F. The following types of fasteners shall not be used:

1. Lead anchors or studs;
2. Wooden plugs or anchors;
3. Plastic anchors;
4. "Nail-in" anchors, either of plastic or metal type.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the Work of this Section in accordance with the Contract Documents.

B. Report immediately to the Engineer any electrical, structural or related construction defects in areas where supporting devices are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

3.02 PREPARATION

Before installation the supporting devices, the Contractor shall investigate the site condition to determine, what preparatory work, if any, will be needed.

3.03 INSTALLATION

A. General

1. Install hangers and supports, sleeves and fasteners in accordance with approved printed manufacturer's installation procedures, and as specified.
2. Coordinate all affected trades and all aspects of the electrical work, including installation of raceways and wiring as necessary to interface installation of supporting devices with other work.
3. Install hangers and supports, and attachments to properly support raceways, equipment and accessories from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze hangers where possible. Install hangers and supports with maximum spacing not to exceed that permitted by NFPA 70 and NECA 5055, as applicable, unless otherwise shown on the Contract Drawings.
4. Secure threaded rod couplings, trapeze hangers or supports or similar horizontal elements, using lock washers and jam nuts to prevent loosening.

B. Conduit and Raceway supports

1. Do not support raceways from hung ceiling supports or members, or metal roof deck.
2. Do not support raceways from mechanical ductwork, ductwork supports, piping or piping supports.

3. Threaded rod for the support of conduits, raceways or trapeze hangers of the given size, shall be not less than the following:

Conduit, Raceway, Hanger Size (inches)	Threaded Rod Size (inches)
2 or less	3/8
2-1/2 to 3-1/2	1/2
4 to 5	5/8
6	3/4

4. Where trapeze hangers are used, bolt or clamp the raceways in place to at least every third hanger and to the first hanger on each side of a bend, fitting, junction or pull box or change in direction.

C. Sleeves

1. Unless otherwise shown on the Contract Drawings, extend sleeves for raceways and risers one inch beyond top of finished floor, curb or building element being penetrated.
2. Install sleeves level and plumb, accurately located and positioned to conform to the requirements of the equipment and in accordance with the approved layout drawings.
3. Install interlocking modular seals in tandem, one at the interior and one at the exterior face of the pipe sleeve.
4. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

D. Fasteners

1. Wood screws, lag screws, carriage bolts or machine screws shall be utilized for wood or materials of similar fibrous nature.
2. Welded or blazed threaded studs, bolts or machine screws or clamps shall be utilized for structural and miscellaneous steel, iron or other metals.
3. Metallic expansion shields, wedge anchors or drop-in anchors, with lag screws, bolts or machine screws shall be utilized for solid masonry or concrete.
4. Sleeve anchors, drop-in anchors or toggle bolts shall be utilized for concrete masonry units (CMU). Do not use powder-activated fasteners in CMU.

E. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.
2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16190A01 Submit layout drawings for dimensioned locations of inserts, sleeves and anchors when required by the Contract Drawings.

Catalog Cuts

16190B01 Catalog cuts
a. Hangers and supports
b. Sleeves
c. Fasteners

Calculations

16190H01 Submit calculations for the following:
a. Supporting steel sections and channels, properly reflecting installed and future loading, including:
1. Safety factors of not less than 4 to 1.
2. Deflection ratio of not greater than 1/240.
b. Special hangers and supports shown on the Contract Drawings
c. Hangers, supports and fasteners when required by but not specifically shown on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 16

SECTION 16250

TRANSFER SWITCHES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for all low voltage transfer switches and appurtenances.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	Underwriters' Laboratories, Inc. (UL)
UL 1008	Standard for Automatic Transfer Switches.
	National Fire Protection Agency (NFPA)
NFPA 70	National Electrical Code.
NFPA 72	National Fire Alarm Safety Code.
NFPA 20	Centrifugal Fire Pumps.
NFPA 110	Emergency and Standby Power Systems.
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
IEEE 241	Recommended Practice for Electric Power Systems in Commercial Buildings.
IEEE 472	Relays and Relay Systems Associated with Electric Power Apparatus.
IEEE 587	Surge Immunity in Solid State Control System.
	National Electrical Manufacturers Association (NEMA)
NEMA ICA10	AC Automatic Transfer Switches (formerly ICS2-447).
NEMA ICA-2	Standard for Industrial Control Devices and Controller and Assemblies.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The automatic transfer switches shall be designed and manufactured in accordance with the applicable provisions of ANSI, IEEE, NEMA, NFPA and UL. Where a discrepancy exist between the standards, the most stringent requirements shall apply. In addition, specific provisions cited herein, and those shown on the Contract Drawings shall govern for the associated specific application.

1.04 QUALITY ASSURANCE

A. Transfer Switch and all components of the type and size indicated shall have been satisfactorily used in a similar purpose for not less then three years.

B. Tests requiring certified reports and those requiring factory or field inspection shall be conducted and reported to the Engineer in conformance with the standards herein specified. All electrical materials and equipment for which there are established UL standards shall bear the UL label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in the original packaging in a manner to prevent soiling, damage, wetting or corrosion, prior to installation.

B. Handle in a manner to prevent damage to finished surfaces.

C. Where possible, maintain protective coverings until installation is complete, and remove such covers as part of final cleanup.

D. Touch-up damages to finishes to match adjacent surface, including recoating of galvanized or plated surface where damaged, cut or drilled.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section and as shown on the Contract Drawings, provide automatic transfer switch products of manufacturers listed on the Contract Drawings.

2.02 MATERIALS

A. Automatic Transfer Switches (ATS)

Furnish and install the ATS with number of poles, amperage, voltage and accessories as required or indicated on the Contract Drawings, and options as indicated on the Contract Drawings. The ATS shall have a Withstand and Closing Rating (WCR) greater than the available fault current at the switch terminal. The ATS shall conform to the requirements of NEMA CS 10, UL 1008, and shall be rated for a total system load as per NFPA-70, NFPA-110 and NFPA-72.

1. Accessories

a. Switching Neutral: Unless otherwise shown on the Contract Drawings, the ATS for all 3 phase 4 wire systems shall be provided with switching neutral contacts.

b. Isolation Bypass Switch: Unless otherwise shown on the Contract Drawings, the ATS for the building emergency riser (where interruption in power distribution can not be afforded for maintenance or repair work) shall be provided with an isolation bypass switch.

2. Options

a. Feeder over current protection: Provide over current and short circuit protection on both incoming feeders (emergency and normal power) using fused switch units or molded case circuit breakers. The protection ratings shall be coordinated with the distribution system.

b. In-Phase Load Transfer Controls: Provide when connected loads are motor loads or when the load characteristic is unknown and the transfer switch will frequently transfer between both available sources. An arrangement of the adjustable time delay during the switching (the time when loads are isolated from both sources) is acceptable only when switching is coordinated with the connected load characteristic and their protection.

c. Engine Generator Controls: Provide when connected emergency power is directly fed from the individual generator.

d. Monitoring Network interface: Provide if the switch is intended to interface with the building management system.

B. The complete ATS shall be factory assembled and tested prior to shipment.

C. Unless otherwise shown on the Contract Drawings, the enclosure for the ATS up to 400 amps shall be NEMA 1B non-ventilated wall mounted.

2.03 CONSTRUCTION FEATURES

A. Automatic Transfer Switch

1. Transfer switch shall be rated to carry 100 percent of the rated continuos current. Transfer switch shall be continuously rated in ambient temperatures of -20 to +50 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet.

2. Transfer switch shall withstand the magnitude of fault current available at the switch terminals or as specified on the Contract Drawings.

3. Transfer switch shall be double-throw, mechanically interlocked, and mechanically held in either position.

4. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

5. Provide auxiliary contacts (2 N.O. and 2 N.C.) rated 10 amps at 250vac on both "Normal" and "Emergency" sides, to be operated by the transfer switch.

6. Electrical operation shall be accomplished by a linear, operating mechanism that receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operator is prohibited. The operating transfer time in either direction shall be one-sixth of a second or less. Main operator shall be momentarily energized to operate, and mechanically held.

7. Transfer Switch shall have a fully rated insulated neutral bus unless otherwise specified with a switching neutral.

8. Enclosure shall be UL listed. The enclosure shall provide NEC required wire bending space. The cabinet door shall be key locking. Controls on cabinet door shall be key operated. Provide switch position indicator lamps and power available lamps for both sources (four total) on the outside cabinet door.

9. Transfer switch shall be mounted in an enclosure as designated on the Contract Drawings. The enclosure shall be NEMA type as specified. The cabinet shall be provided with NEC required wire-bending space at point of entry as shown on the Contract Drawings. Manual operating handle and all control switches (other than key-operated switches) shall be accessible to authorized personnel, only by opening the key-locking cabinet door.

10. Control shall be solid-state and designed for a high level of immunity to power line surges and transients, and demonstrated by test to IEEE Standard 587-1980.

11. Voltage sensors shall simultaneously monitor all phases of both sources. The control panel shall be microprocessor and/or solid state analog type with adjustable sensing and timing functions. All sensing and time delay functions shall be adjustable over the ranges indicated and shall operate with minimum drift (not to exceed +10 percent of set frequency, +2 percent of set voltage, and +10 percent of set time delay) over the temperature range of -20 degrees to +50 degrees C. The control panel shall be provided with a protective cover. All control wires between the control panel and main transfer switch shall be terminated on a terminal strip.

The following operational characteristics shall be provided:

a. Voltage Sensing

(1) Normal Source: Differential voltage of all phases (pickup adjustable from 85-100 percent of nominal voltage and drop out adjustable from 75-98 percent of pickup voltage) shall be factory set to pick up at 95 percent and drop out at 85 percent of nominal voltage. Sensing shall be on the line side of the transfer switch main controls unless otherwise shown on the Contract Drawings.

(2) Emergency source: Independent single phase voltage (85-100 percent for dropout) and frequency (90-100 percent for pick-up) sensing to prevent premature transfer shall be factory set to pickup at 90 percent of nominal frequency and 100 percent voltage, and dropout at 85 percent voltage.

b. Time Delay Setting

(1) Time delay on momentary dips in normal source (0.5 -6.0 seconds) shall be factory set at 1.0 second.

(2) Time delay on transfer to emergency shall be 0 to 2 minutes, factory set to 0 minute or as shown on the Contract Drawings. If specified at more than 2 minutes, an additional extend time delay component shall be provided.

(3) Time delay on retransfer to normal source shall be 0-30 minutes, factory set at 30 minutes, and an additional retransfer bypass switch (toggle switch) shall be provided.

12. Provide a key operated selector switch or momentary test switch in a secure location to simulate failure of normal source and restore back to normal.

13. Transfer switch shall be equipped with manual operators for service use, to operate under a de-energized condition.

14. Accessories

a. Switching Neutral

Switching neutral shall be the 4th pole, 100 percent rated and simultaneously operated with other power poles using the same actuator. This feature shall provide one of the following schemes unless otherwise indicated on the Contract Drawings.

(1) Fourth pole similar to other power poles to be connected to a common crossbar with operation arranged to break before make and lagging in opening and leading in closing as compared to the power poles.

(2) Overlapping switching neutral connected to a common operator with operation arranged to make before break.

b. Bypass Isolation Switch

Bypass Isolation switch shall be constructed to provide a safe means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load without interruption, and to isolate the transfer switch from both sources. The switch equipment shall be UL listed per Standard 1008, CSA approved; with continuos current rating, voltage and frequency ratings, and withstand closing ratings equal to the transfer switch ratings and provide the following construction features.

(1) The bypass-isolation and switch shall be mechanically held in each position. The switch mechanism shall be of a stored energy contact type. No interruption of power is acceptable. The speed of the contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.

(2) The bypass switch shall provide bypass to either normal or emergency source by use of a permanently mounted, external operating handle.

(3) The bypass switch shall provide manual bypass without load break.

(4) Positive electrical and mechanical interlocks shall prevent all possible source to source interconnections. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.

(5) A drawout isolation mechanism shall provide closed-door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open before the mechanism will permit isolation of the transfer switch. The isolation mechanism shall provide for a three-position operation; Connected, Test and Isolated.

(6) In the Connected position, isolation contacts shall be fully engaged and closed with the control cable connected. In the Test position, isolation contacts shall be open with the control cable connected. The Test position shall allow operational testing of transfer switch and controls without power disruption to the load. In the Isolated position, the transfer switch and control cable shall be completely isolated from all power sources. In the Isolated position, safety shutters shall close to cover bypass switch power terminals, minimizing the possibility of accidental contact with energized parts.

(7) In the Isolated position, the transfer switch shall be capable of being withdrawn from the cabinet. When re-installing the transfer switch, the isolation mechanism shall not permit connection of the transfer switch unless it is in the open position, or closed position on the same source as the bypass switch.

15. Options

a. Feeder over current protection shall be provided using either fused switch units or molded case breakers. The proper isolation shall be provided between the ATS and over current protection enclosures. The power connection shall be supplied with silver plated copper bus bars. The protection rating shall be coordinated with feeder size, available short circuit levels and connected loads.

b. In-phase load transfer control shall be similar to automatic synchronized transfer, by sampling the source voltage and residual voltage (slipping frequency) of the load side. The control shall be coordinated with the transfer switch speed and actively interfaced with residual voltage and frequency. The switching time delay feature can be acceptable only if it meets system distribution needs and is specified on the Contract Drawings. The switching time delay shall be field adjustable with a range of 0 to 7.5 seconds.

c. Engine generator controls shall integrate engine start and engine exercising features with transfer switch controls, and shall be provided with a voltmeter, ammeter and frequency meter.

d. Monitoring network interface shall be capable of interfacing through a standard IEEE bus and open protocol.

16. Enclosure

The enclosure type shall be as designated on the Contract Drawings. Enclosure construction shall be welded steel. Wire bending space shall comply with National Electrical Code for the maximum size and number of conductors the terminal lugs will accept. A key locking handle shall be provided.

PART 3. EXECUTION

3.01 FIELD SUPERVISION

A. Provide the services of a qualified, factory-trained ATS manufacturer's representative to provide technical field support in the installation and testing of the equipment specified in this Section. The manufacturer's representative shall provide technical direction and assistance in the following:

1. Direct the ATS installation and field control wiring connection.
2. Perform Required Field Testing.
3. ATS load transfer control parameters setting.

3.02 EXAMINATION

The Contractor is responsible for notifying the Engineer as soon as he finds conditions that prevent the proper installation of materials or methods specified in this Section.

3.03 INSTALLATION

A. The ATS shall be transported to the construction site, unloaded, uncrated, handled, stored, installed, including assembly of all component parts, and wired in accordance with the manufacturer's recommendations, applicable IEEE (formerly ANSI) standards, and the requirements specified in this Section.

B. Provide all equipment, supervision, labor, rigging, tools, including, but not limited to, special equipment such as cranes.

C. Before setting the ATS, the openings for conduits and bus entrances shall be checked for accuracy of position.

D. All floor-mounted ATS units shall be set on a concrete pad at the locations shown on the Contract Drawings. Provide floor seals at the penetration. The ATS shall be set, aligned, and leveled in place, using shims where necessary.

E. Bus splices shall be cleaned and bolted together and insulated, either by taping, or by use of insulating boots if provided for that purpose.

F. The Contractor shall complete all internal and external power and control connections. All field-installed control wiring shall be identified using heat-shrinkable wire sleeves with origin/destination markings typed on them.

G. Install, wire, and connect the controls in accordance with the Contract Drawings and manufacturer's drawings and instructions.

H. All damaged paint areas shall be properly prepared by the Contractor for an application of primer and finish coats of paint, which shall be supplied by the manufacturer for this purpose. The Contractor shall apply the primer and finish paint coats.

I. After each item of equipment is installed and connected, the Contractor shall make a thorough inspection of the installation and cleaning, prior to final acceptance of the Work.

J. All control cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures. Minimum bending radius recommended by cable manufacturers shall not be reduced.

3.04 FIELD TESTS

Field tests shall be performed in accordance with Approved Performance Test Plan of Appendix "A". Advise the Engineer, in writing, upon failure of any equipment or material to pass the tests performed, or to function properly as intended. In the event that testing does not meet the requirement for proof of satisfactory performance specified herein, the Contractor shall repeat the test. The Engineer reserves the right to decide whether a test must be repeated.

3.05 PROTECTION

Protect ATS and facilities against damage, mechanical or otherwise and provide maintenance until issuance of the Certificate of Final Completion. The switchgear and equipment shall be kept clean, dry, and protected at all times.

3.06 TRAINING

A. Provide training sessions for the number of Authority personnel, as specified on the Contract Drawings.

B. The training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly and major components within the assembly.

C. For additional training time requirements, see Section 16000 of these Specifications.

END OF SECTION

SECTION 16250

TRANSFER SWITCHES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16250A01 Shop Drawings
a. Schematic wiring diagrams
b. Control wiring diagrams
c. Dimensional data
d. Description of operation

Catalog Cuts

16250B01 Catalog cuts
a. Transfer switches

Manufacturer Test Reports

16250F01 Test Reports
a. Factory test reports
b. Certified Laboratory Test Data
c. Prepare, and submit to the Engineer for approval a Performance Testing Plan for the entire system a minimum of 30 days in advance of the earliest, approved, scheduled inspection and test date. The system shall be divided into the following stages:
1. Inspection upon arrival at the construction site.
2. On site inspection and test immediately following the complete installation of the system to demonstrate compliance with the requirements of this section.
3. A 30-day operational test commencing with the successful completion of the on site inspection and test.

Construction and Installation Procedures

16250G01 Prior to delivery, the Contractor shall submit procedures covering storage and preventative maintenance requirements to be applied after the receipt of the circuit breakers at the construction site.

16250G02 Training - Prior to the on site inspection and test of the system, prepare and submit to the

Engineer for approval an emergency load transfer system curricula, in accordance with the requirements of this section.

Spare Parts List

16250N01 Spare Parts

a. Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this section for approval by the Engineer.

b. Submit a list of recommended spare parts together with indications of what the price and delivery time of each part, starting from receipt of order, will be if such parts are ordered.

END OF APPENDIX "A"

DIVISION 16

SECTION 16320

DRY - TYPE TRANSFORMERS
GENERAL PURPOSE - 600 VOLTS OR LESS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for general purpose, dry-type transformers 600 volts or less.

1.02 REFERENCES

Not Used.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The transformers shall be designed, manufactured and tested in accordance with the applicable provisions of the codes, standards and recommendations of the following entities:

American Welding Society (AWS)
American National Standards Institute (ANSI)
Institute of Electrical and Electric Engineers (IEEE)
National Electric Manufacturers Association (NEMA)
National Fire Protection Association (NFPA)
Underwriter Laboratories Inc. (UL)

In addition, specific provisions cited herein and as shown on the Contract Drawings shall govern for the associated specific application.

1.04 QUALITY ASSURANCE

A. The manufacturer of transformers shall have manufactured equipment of the voltage and KVA rating(s) described herein and as shown on the Contract Drawings, and they shall have been satisfactorily used for the purposes similar to those intended herein for a minimum of three years. When directed by the Engineer, the Contractor shall have the manufacturer provide a list of installations and contracts for which he has produced such materials.

B. All Work of this Section shall be performed and completed in a thorough, workmanlike manner and shall follow the best modern practice in the manufacture of high-grade equipment. All Work of this Section shall be performed by mechanics skilled in their respective trades.

C. All parts shall be made accurately to standard gauge, where applicable, for ease of replacement and repairs.

D. All material selected for the manufacture of the transformer units shall be the best available for the purpose for which they are intended to be used, considering strength, ductility, durability and the best engineering practice.

E. All parts shall be readily accessible and like parts shall be interchangeable insofar as possible.

F. Surfaces to be welded shall be clean and free from dirt, rust or other foreign matter. The welding processes shall be in accordance with the requirements specified by AWS.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transformers shall be delivered complete, in the manufacturer's original, unopened protective packaging. All accessories, including but not limited to meters, temperature gauges, lightning arrestors, fan controls and relays, shall be in place and wired. Packing materials shall be such as to prevent damage to components due to vibration, jarring or the like during transportation and handling.

B. Accessories or spare parts shipped loose shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with a non-corrosive tag.

C. The transformers shall be handled in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES

A. General

Unless otherwise shown on the Contract Drawings, transformers shall conform to the following requirements:

1. Transformers shall be self-cooled, with properly designed steel enclosures. Openings for ventilation or similar use shall be so designed as to deflect foreign objects inserted through these openings away from contact with energized parts. Enclosures shall be suitable for floor or wall mounting, as required to fit within the constraints of each specific application. Transformers larger than 112.5 KVA shall be designed for floor mounting only. Outside dimensions of enclosures shall not exceed the dimensions shown on the Contract Drawings.

2. Transformers shall be provided with four 2 1/2 percent full capacity taps in the primary winding, two above and two below the nominal voltage rating. The taps shall be factory-wired to terminals accessible only by removal of external access plates or panels.

3. The maximum temperature at any spot on the exterior surface of the enclosure shall not exceed 50 degrees C rise above a 40 degrees C ambient.

4. Each transformer as a unit shall be capable of withstanding the stresses resulting from operating conditions, including external and internal short circuits, without distortion or other damage.

B. Core and Coil

1. Core and coil shall be completely isolated from the enclosure by rubber vibration isolating pads. The core shall be visibly grounded to the enclosure by a flexible grounding conductor, sized in accordance with applicable NEMA, IEEE and ANSI standards.

   a. Transformer neutral lead shall be ungrounded and brought-out to an isolated terminal.

   b. The enclosure shall include ground connection lugs for the incoming and outgoing conduits, and provisions for grounding the isolated neutral lead, all as shown on the Contract Drawings.

2. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. Cores shall be clamped with structural angles and bolted to the enclosure to prevent damage during shipment or rough handling. All laminations shall be cut with the direction of the grain and be free of burrs, core plated and stacked without gaps.

3. Windings shall be copper-formed wire or sheet, continuous from start to finish. Splices in windings will not be permitted. Material incorporated must have at least a minimum of one year of proven field usage. Accelerated laboratory tests will not be acceptable.

4. Internal primary and secondary bus shall be rectangular copper. All buses shall be hot-dipped, silver-plated over the entire area where incoming or internal cable or bus are to be bolted.

5. Transformer impedance shall be within 7-1/2 percent of the impedance value shown on the Contract Drawings.

6. All joints and leads to the transformer terminals shall be braced or welded.

7. The basic impulse level (BIL) windings shall be a minimum of 10 KV.

C. Insulation Systems

Transformers shall be vacuum-impregnated with non-hygroscopic thermosetting varnish.

1. Transformer capacity shall be based upon a temperature rise of 80 degrees C for transformers 30 KVA and larger, and 115 degrees C for transformers less than 30 KVA above an ambient temperature of 40 degrees C.

   a. Transformer design for 115 degrees C rise shall be capable of delivering a 15 percent continuous overload, above nominal rating, without exceeding 150 degrees C rise above a 40 degrees C ambient temperature.

   b. Transformer design for 80 degrees C rise shall be capable of delivering a 30 percent continuous overload, above nominal rating, without exceeding 150 degrees C rise above a 40 degrees C ambient temperature.

2. Transformer insulation systems shall be 220 degrees C for transformers 30 KVA and larger, and 185 degrees C for transformers less than 30 KVA. All insulating materials shall conform to the requirements of NEMA ST 20, for 220 degrees C, UL recognized insulation systems.

D. Sound Levels

Transformers shall operate at sound levels at or below ANSI C 89.1, and as follows:

Transformer Size	Maximum Sound Level
0.1 to 9 KVA	40 db
10 to 50 KVA	45 db
51 to 150 KVA	50 db
151 to 300 KVA	55 db
301 to 500 KVA	60 db

E. Painting

The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed and finished with two coats of ANSI 61 light gray, baked enamel.

2.02 FACTORY INSPECTION AND TESTS

A. The Engineer reserves the right to inspect each transformer 112.5 KVA and larger at the factory and to witness each factory test. The Engineer shall be notified 15 working days in advance of each test. Failure to notify the Engineer of testing may necessitate retesting in the presence of the Engineer at no additional cost to the Authority.

B. The accuracy of the calibration of all instruments to be utilized during the tests shall be ascertained and recorded at the beginning of the tests.

C. Factory tests shall include, but not be limited to, the following:

Submit certified test data of new transformer designs, or of electrically duplicate transformer designs. The required test data shall be:

1. Efficiency at 25, 50, 75 and 100 percent load.

2. Percent regulation at 80 and 100 percent power factor.

3. No load and full loss in watts.

4. Impedance based on reference temperature.

5. Sound level in db of transformer in enclosure.

6. Average temperature rise based on 40 degrees C ambient temperature.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install transformers in accordance with the Contract Drawings, the manufacturer's instructions and in compliance with the applicable requirements of ANSI, IEEE, NFPA and UL.

B. All conduit and bus connections to the transformer enclosures shall be made with flexible or other approved vibrationless connectors.

3.02 FIELD TESTS

A. General

1. Provide all labor and materials for functional tests required. Unless otherwise shown on the Contract Drawings, power for the tests will be furnished by the Authority.

2. Should the tests reveal any defects in transformers installed under this Section, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer.

B. Perform the following field test in the presence of the Engineer to demonstrate the proper phasing of each transformer installation and submit a written field report to the Engineer for record:

1. Verify that the proper phase sequence is maintained.

2. Use a phase sequence meter or demonstrate the proper rotation of a small 3-phase motor whose direction of rotation was verified prior to the transformer installation.

3. Should the foregoing test reveal any incorrect phasing, promptly correct such defects and retest until the entire installation is satisfactory to the Engineer.

END OF SECTION

SECTION 16320

DRY TYPE TRANSFORMERS - GENERAL PURPOSE - 600 VOLTS OR LESS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16320A01 Shop Drawings
a. Physical dimensions of each transformer
b. Nameplate drawing for each transformer
c. Drawings showing location of all specified accessories
d. Technical specification for proposed transformer
e. Wiring diagram of fan cooling provisions
f. Details of current transformers

Catalog Cuts

16320B01 Catalog Cuts
a. Temperature gauges
b. Lightning arrestors

Manufacturer Test Reports

16320F01 Submit six copies of the certified test reports.

END OF APPENDIX "A"

DIVISION 16

SECTION 16335

LOW VOLTAGE SWITCHGEAR

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for metal-enclosed, low voltage draw-out type power circuit breaker switchgear.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 37.13	Low-Voltage AC Power Circuit Breakers used in Enclosures
ANSI C 37.16	Standard for Switchgear - Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C 37.20.1	Standard for Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
ANSI C 37.27	Standard Application Guide for Low-Voltage AC Non-integrally Fused Power Circuit Breakers (Using Separately Mounted Current-Limiting Fuses)
ANSI C 37.50	Test Procedures for Low-Voltage AC Power Circuit Breakers used in Enclosures
ANSI C 37.51	Standard for Switchgear - Metal Enclosed Low - Voltage AC Power - Circuit-Breaker Switchgear Assemblies - Conformance Test Procedures
ANSI C 37.90	Standard for Relays and Relay Systems Associated with Electric Power Apparatus
ANSI C 57.13	Standard Requirements for Instrument Transformers
	National Electrical Manufacturers Association (NEMA)
NEMA AB 1	Molded Case Circuit Breakers
NEMA ICS 1	General Standard for Industrial Controls and System
NEMA ICS 2	Standards for Industrial Control Devices and Controllers and Assemblies
NEMA ICS 4	Terminal Blocks for Industrial Equipment and Systems
NEMA SG 3	Low Voltage Power Circuit Breakers
NEMA SG 5	Power Switchgear Assemblies

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code

Underwriters Laboratories (UL)

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 1066	Low Voltage Power Circuit Breaker
UL 1558	Metal Enclosed, Low Voltage Power Circuit Breaker Switchgear

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The switchgear shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ANSI, NEMA, and UL Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

1.04 QUALITY ASSURANCE

A. Switchgear and all components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities manufacturing equipment shall have experience on at least two projects involving complexities similar to those required under this Contract.

C. When shown on the Contract Drawings, the switchgear shall be listed and labeled by a "Nationally Recognized Testing Laboratory" (NRTL), as defined by OSHA Regulations.

D. The switchgear and circuit breakers shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 0.75g, and a Zero Period Acceleration (ZPA) of 0.38g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35 Hz.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipment, the switchgear assembly shall be cleaned by wiping with a clean, dry cloth. Oil and grease marks shall be removed and wiped dry. All insulation shall be cleaned thoroughly. Dirt, soot, grease or paint shall be removed from the circuit breaker contacts and surface of the entire current carrying structures.

B. All relays and instruments shall be firmly blocked to prevent damage during shipment.

C. The overall dimensions and weight of each shipping section shall be limited to the maximum allowable by applicable state and local codes governing shipment of materials over public roads or construction site handling limitations, whichever is less. Each shipping section shall have a label indicating dimensions and weight.

D. All equipment and materials shall be suitably wrapped, crated, boxed or otherwise prepared for shipment to prevent damage during handling and shipping. All openings shall be properly protected to prevent the entrance of any dirt or debris. All parts not constructed to be normally exposed to the weather shall be suitably weatherproofed.

E. Each box or crate shall be equipped with suitable lifting devices to facilitate unloading and shall contain a detailed packing list.

F. Packaging shall be labeled and numbered so that each section or assembly may be identified before being uncrated. Any items not fully assembled to the switchgear structure shall be packaged separately. Removable circuit breaker units shall be packaged and shipped separately.

G. Adequate means shall be provided for lifting by fork lifts and cranes and for moving the equipment on rollers. Lift points shall be marked on each crate.

H. Indoor switchgear that cannot be installed immediately shall be stored in a dry, clean location within a heated building. During storage, the switchgear shall be placed on a level surface.

I. Outdoor switchgear that cannot be installed immediately shall have its space heaters temporarily connected and energized so as to prevent condensation of moisture within the housing.

1.06 SPARE PARTS AND SPECIAL TOOLS

A. A minimum of six (6) spare fuses of each size and type used in the switchgear shall be furnished.

B. Furnish one set of all special tools required for the erection, operation, and maintenance of all equipment furnished.

C. Furnish a minimum of three (3) half-pint containers of paint matching the exterior finish of the enclosure.

D. Furnish six (6) spare indicating lamps of each type installed.

E. Furnish one (1) container of contact lubricant.

F. When shown on the Contract Drawings, furnish one (1) portable, breaker-lifting device.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide metal-enclosed, low voltage power circuit breaker switchgear products of manufacturers listed on the Contract Drawings.

2.02 RATINGS

The switchgear shall have the following ratings, as shown on the Contract Drawings:

A. Nominal System Voltage.

B. Rated Maximum Voltage.

C. Rated Frequency.

D. Rated Insulation Level.

E. Rated Continuous Current.

F. Rated Short-Time Current.

G. Rated Short-Circuit Current.

H. Short Circuit Current Bus Bracing.

I. Control Voltage.

2.03 CONSTRUCTION FEATURES

A. General

1. Switchgear shall be factory assembled, suitable for indoor or outdoor use, as shown on the Contract Drawings, dead front, metal enclosed, free standing, and completely equipped with removable low voltage power circuit breakers, fuses, instrument transformers, relays, metering, switches, and associated devices as described herein and as shown on the Contract Drawings and conforming to ANSI C 37.13, C 37.16, C 37.20.1, C 37.27, C 37.50, C 37.51, NEMA SG 3, SG 5, NFPA 70, and UL 1066, 1558.

2. When shown on the Contract Drawings, the switchgear shall be arranged for close coupling to the transformer secondary through a transition compartment. Provisions shall be made for extension of the switchgear in both directions.

3. All breakers shall be arranged as shown on the Contract Drawings.

4. No polyvinyl chloride (PVC) materials, insulation or products shall be used in switchgear, except for removable insulating boots on bus work.

B. Assembly Features

1. The switchgear shall consist of rigid self-supporting vertical sections bolted together to form a rigid assembly. Each cubicle shall be completely enclosed with formed steel sheets adequately braced to prevent distortion under normal conditions as well as during interruption of short circuit currents.

2. The structural details of each cubicle for the same breaker rating shall be identical. The cubicles shall be uniform in height and depth, and built to form a continuous structure lining up in front and rear.

3. All louvers or other ventilating openings shall be protected against falling of dust, water, or other foreign material. No louvers or ventilation openings shall be located on top of the switchgear unless they are made drip-proof and approved by the Engineer prior to fabrication.

4. Sheet steel doors shall be provided for access to the circuit breaker compartments, instrument compartments, and cable compartments.

5. Doors shall be furnished with one or more handles, knurled steel screws, or a combination of these in order to firmly hold door closed. Doors shall be padlockable. Doors shall be reinforced with stiffeners to minimize vibration. Stops shall be provided to hold doors in the open position. Doors shall be furnished with galvanized, zinc plated or stainless steel hinges and hinge pins. Doors shall open at least 135 degrees.

6. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

7. All insulating materials used for bus supports, barriers, or covers shall be of high dielectric strength, low moisture absorbing, flame retardant, arc resistant, and high impact strength material.

8. All combustible materials used for barriers, covers and the like shall meet the flammability test criteria of UL 94 for materials classed 94V-0.

9. Space heaters, with mechanical guards to prevent inadvertent contact of personnel with thermal element, shall be provided in each vertical section. Heaters shall be of the low temperature type, rated 240 volts and operated at 120 volts, each protected by an individual single pole molded case circuit breaker of suitable rating. The heaters shall be sized to keep the air inside the cubicle above its dew point. Heaters shall be thermostatically controlled. Thermostats shall be of the differential type and preset by the Contractor.

C. Circuit Breaker Compartment

1. The primary connection between the stationary units and the removable circuit breakers shall be made by means of a set of self-aligning, disconnecting devices mounted on the breaker studs or in the stationary structure, which shall positively engage with solid studs mounted in the stationary structure or on circuit the breaker, respectively. Firm contact pressure shall be maintained by means of steel coil springs. All primary contact surfaces shall be silver plated to prevent corrosion.

2. Each circuit breaker cubicle shall be equipped with an automatic safety shutter to close the entrances of the stationary primary disconnecting devices when the breaker is removed or in the test position.

3. The removable breaker element shall be connected to and disconnected from its operating position by a suitable engaging mechanism. Guides shall be provided to assure perfect alignment of all engaging parts of the removable breaker element with the corresponding parts in the stationary structure. A positive stop shall prevent over-travel of the removable breaker element when it is advanced to the connected and test positions.

4. Each breaker cubicle shall be equipped with a mechanical interlock which shall prevent the circuit breaker from being inserted or withdrawn from the connected position unless the breaker is opened. Another mechanical interlock shall prevent the breaker from being closed unless the primary disconnecting devices are in full contact or separated by a safe distance, such as in the test or disconnected position.

5. Each circuit breaker cubicle shall be furnished with provisions for locking the circuit breaker in the disconnected position

6. Cubicles containing current interrupting devices shall have ventilating provisions to minimize the movement of ionized gases between compartments or to the outside. Ventilating openings shall be rodent proofed by covering with a protective grill or wire mesh securely held in place.

D. Circuit Breaker Fuse Compartment

1. When shown on the Contract Drawings, non-integrally mounted Current Limiting Fuses for the protection of the removable circuit breaker, shall be mounted inside a switchgear cubicle or compartment on a drawout carriage similar to that used for the circuit breaker. The fuses shall be connected to the line side of the circuit breaker.

2. The fuse cubicle or compartment shall be equipped with an automatic safety shutter to cover the line and load disconnects when the carriage is removed from its compartment. A rejection feature shall be furnished so that only the correct carriage can be inserted in the compartment.

3. A hinged panel shall be positioned in front of the fuses so that they cannot be reached if the compartment door is open. The panel shall be interlocked to prevent it from being swung open unless the fuse carriage is fully withdrawn.

4. A key interlock or mechanical interlock system shall be installed in the associated circuit breaker compartment and fuse carriage compartment to prevent racking of the fuse carriage with circuit breaker in the closed position.

E. Cable Compartments

1. Size the cable compartment to accommodate all incoming and outgoing cables in compliance with NFPA 70. Cable compartments shall include cable supports. Where connections are to be made to busways, all necessary bus adapters, bolting, insulating supports, and metal flanges shall be provided. Ground sensing current transformers, when shown on the Contract Drawings, shall be mounted in the respective cable compartments.

2. All cables will enter the equipment as shown on the Contract Drawings. Compression crimp-type cable lugs shall be provided for power cables. Lugs shall have standard NEMA bolt hole spacing.

F. Barriers

1. Each individual vertical section shall be segregated from adjacent sections by means of steel barriers extending all the way to the rear of the section.

2. Each individual cable compartment shall be provided with a steel, or insulating barrier between the cable compartment and the main bus to protect against inadvertent contact with the main or vertical bus bars, and to ensure that no live connections are accessible in the rear of each section except the circuit breaker load connections.

G. Enclosures

1. Indoor switchgear shall be provided with a NEMA 1 enclosure.

2. When specified on the Contract Drawings, outdoor walk-in type switchgear shall be provided with the following features:

   a. Switchgear shall be enclosed in a NEMA 3R enclosure conforming to all applicable requirements of UL. The enclosure shall have a roof sloping toward the rear. Outer sections shall be the same widths as indoor structures, except the end sections of a walk-in enclosure shall be wider than the inner sections to permit opening the inner door. Each end of the outdoor structure shall have an end trim. Front aisle depth for walk-in structures shall be 42 inches, minimum.

   b. The enclosure shall be provided with rear hinged doors for each section. Aisle doors shall be supplied with provisions for padlocking. A steel floor shall be provided in walk-in aisle space and under each vertical section. Ventilating openings shall be provided complete with replaceable fiberglass air filters.

   c. Provide panic door hardware on aisle doors at each end of the line-up. External padlocking of the aisle doors shall not prevent operation of the panic hardware from the interior of the enclosure. The construction of the enclosure shall be modular so future sections can be added without affecting NEMA 3R integrity. Provide interior aisle lights, 3-way switches, and GFI protected receptacles.

   d. The enclosure shall be provided with undercoating applied to all members in contact with the foundation surface to retard corrosion.

   e. Power for the space heaters, lights, and receptacles shall be obtained from a control power transformer (CPT) within the switchgear, unless otherwise shown on the Contract Drawings. Supply voltage shall be 120 VAC.

   f. An overhead traveling hoist for handling circuit breakers shall be provided in the aisle of the enclosure.

3. When specified on the Contract Drawings, outdoor, non-walk-in type switchgear. shall be provided with the same features as described above for the outdoor walk-in type switchgear, except for the aisle. In addition, the front of each vertical section shall have a weatherproof door.

H. Utility Metering Section

1. Where indicated on the Contract Drawings, provide a separate barriered-off utility metering compartment complete with hinge sealable door. Bus work shall include provisions for mounting utility company current transformers as required by the utility company.

2. Service entrance switchgear section shall comply with U.L. requirements that include Service Entrance Label, incoming line isolation barriers, neutral connection to switchgear ground for solidly grounded wye systems.

I. Pull Boxes

When shown on the Contract Drawings, provide pullbox with the width and depth of the cable compartment. Provide ventilation features to maintain air temperature in pullbox within same limits as in switchgear. Provide cable supports arranged to facilitate cabling and to support cables indicated on the Contract Drawings.

J. Traveling Hoist

Unless otherwise shown on the Contract Drawings, the switchgear shall be provided with an integral traveling hoist for breaker lifting. Traveling Hoist shall be rail mounted on top of the switchgear, movable and hand operated.

K. Buses

1. Buses shall be supported on isolated supports of high-impact, not-tracking, high quality insulation material and braced to withstand the magnetic stresses developed by currents equal to the largest circuit breaker interrupting ratings. Bus bars shall be high conductivity copper having silver-plated joints. All buses, taps and primary interconnections shall be insulated with an approved insulating material, when shown on the Contract Drawings. Tapes or rigid sleeving are not acceptable as an insulating material for bus.

2. Bolts and associated hardware used with current carrying buses shall be of nonmagnetic, corrosion resistant material.

3. Insulating barriers shall be provided where primary buses pass through from one vertical section to another.

4. Neutral bus shall have the same ampacity as the phase bus, unless otherwise shown on the Contract Drawings.

5. Vertical section bus shall be rated for the cumulative circuit breaker loading, conforming to ANSI C 37.20.1, and calculated assuming spaces for future circuit breakers are fully equipped with circuit breakers carrying current at 100 percent of their maximum frame size current ratings, and spare circuit breakers are loaded to the same degree.

6. A copper ground bus extending the entire length of the switchgear cable compartments shall be provided. All the metal parts of the structure shall be effectively connected to this bus. Ground bus shall be of rectangular cross section, not less than 1/4 inch by 2 inches.

L. Control and Auxiliary Power Wiring

1. Control wiring for each cubicle shall be enclosed in conduit or in compartments isolated from the primary circuits and shall conform to NEMA ICS 2.

2. Control and secondary cable shall be tinned copper, minimum class B stranded. Cable shall have insulation type SIS, rated 90 degrees C, 600 volt, heat resistant, and flame retardant. Wires crossing hinged joints and swing panels shall be flexible class K stranded.

3. All control wiring, leaving the switchgear, shall be wired to terminal blocks. Direct connections between devices located in different vertical sections are not acceptable. Connections made on terminal blocks and on internal devices shall be by means of flanged spade or ring type insulation gripping insulated terminals. On devices that do not permit flanged spade or ring type terminals, control wiring shall be held by screw type compression connectors. Internal wiring shall have no splices, nor shall more than two wires be terminated on one terminal point.

4. Control wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances. All current transformer secondary leads shall first be connected to easily accessible short circuit terminal blocks, before connecting to any other device. All groups of control wires leaving the switchgear shall be provided terminal blocks with suitable numbering strips. Where feasible, provide plug-in terminal blocks for all shipping split wires.

5. Wire markers shall be provided at the end of all control wiring, identified by printing on wire sleeve with "origin" and "destination" markings.

6. Wiring shall be sized for the duty required. Control wiring shall be 14 AWG minimum; current transformer wiring shall be 10 AWG minimum. Wiring crossing hinged joints and swing panels shall be 12 AWG with extra flexible stranding.

7. The control circuit wiring between the stationary units and the removable circuit breakers shall be made by means of self-aligning, multi-contact, devices. Only the stationary contacts shall be energized when the circuit is disconnected. All contact surfaces shall be silver-plated.

   a. Suitable means shall be provided for completing the control circuits between the stationary unit and the removable circuit breaker when the circuit breaker is withdrawn from the connected position to the test position.

8. Unless otherwise shown on the Contract Drawings, auxiliary power circuits shall run the entire length of the switchgear. The circuits shall be one phase, 120 volt AC. The source of power shall be as shown on the Contract Drawings.

9. Protection for control and auxiliary power circuits shall be provided by pull-out-type fuse blocks and dual element time delay fuses.

M. Removable Low Voltage Power Air Circuit Breakers

1. Removable low voltage power circuit breakers shall be as shown on the Contract Drawings, as specified herein, and in Section 16475 of these Specifications entitled "OVERCURRENT PROTECTIVE DEVICES", conforming to ANSI C 37.13 C 37.16, C 37.27, C 37.50, NEMA SG3, and UL 1066.

2. All removable elements of the same type, ampere rating, and tripping characteristics shall be interchangeable to the extent that they can be used, will operate, and give complete relay protection in any stationary element with the same ampere rating.

3. An auxiliary switch (TOC) shall be mounted on the stationary housing (switchgear metal barrier) to indicate the connected position of the removable circuit breaker. In addition to the contacts required for the operation of the circuit breaker, the position switch shall consist of two (2) normally open and two (2) normally closed spare contacts.

4. When additional auxiliary switch contacts are needed than can be provided with circuit breaker auxiliary switches, such contacts shall be provided using auxiliary switches (MOC) mounted on the stationary housing. In addition to the contacts required for the operation of the circuit breaker, the position switch shall consist of two (2) normally open and two (2) normally closed spare contacts.

5. Auxiliary switch contacts shall be adjustable to either the normally open or normally closed position.

6. Mechanical interlocks shall be provided to prevent the removable circuit breaker from being moved to or from the operating position with the circuit breaker closed and to prevent the circuit breaker being closed unless primary disconnecting devices are fully engaged or separated a safe distance.

N. Instrument Transformers and Meters

1. Instrument transformers shall conform to ANSI C 57.13.

2. Voltage transformers shall have 120 volt secondary rating, ratio as shown on the Contract Drawings, accuracy classification 1.2Z at rated voltage for ANSI Standard burdens. Voltage transformers shall be capable of a burden at least double the connected load, to allow for portable instruments. Voltage transformers shall be provided with primary current limiting fuses.

3. Control Power Transformer (CPT) shall be designed for machine tool application and shall have voltage regulation and VA rating to limit the voltage drop to 5 percent, under maximum inrush conditions. The VA rating, along with supporting calculations, shall be submitted to the Engineer for approval. The primary and secondary windings of the transformer shall be protected with current limiting fuses, and shall be sized at 300 percent of the CPT rating. The interrupting rating of the primary fuse shall match the short circuit rating of the switchgear.

4. All current transformers shall be 5 amps secondary, ratio and accuracy class as shown on the Contract Drawings. Current transformers shall not saturate when operated at 20 times rated current. Current transformers shall be capable of a burden at least double the connected load. All current transformers shall be terminated in shorting blocks.

5. All current transformers shall be selected to withstand the thermal and mechanical stresses imposed by the maximum available system fault current. The current transformer rating and supporting calculations shall be submitted to the Engineer for approval.

6. Instrument transformer secondaries shall be grounded with a copper conductor not smaller than #10 AWG and connected to a ground bus located as closely as possible to the transformer.

7. Voltage and control power transformer primaries, where connected to ground, shall be grounded with a copper conductor not smaller than #6 AWG which is insulated for line-to-line voltage and terminates at the grounding bus in a lug. The connection to the bus shall be so designed that it can be easily disconnected and isolated for proof testing. Each ground wire shall be one continuous run without intervening splices or terminal blocks between the transformers and the ground point.

8. Metering system shall be as shown on the Contract Drawings and shall be one of the following:

a. Digital Metering System (DMS)

The Digital Meter System shall be compact, microprocessor based, all-in-one built, panel mounted, for measuring phase and neutral current, volts, KW, KVA, KVAR, HZ and power factor. The DMS shall be installed on each unit of the switchgear where metering is required. It shall be connected through current and potential transformers as shown on the Contract Drawings and in accordance with the manufacturer's instructions. The DMS shall be mounted on the front of the switchgear within reach of an observer near eye-level. The DMS shall be capable of being used as a stand-alone monitoring unit, or as one element of a larger SCADA (supervisory control and data acquisition) network. The DMS shall have the capability to communicate via an RS-232 or RS-485 port. A minimum of three output relays shall be provided in the DMS unit that can implement alarm, control, or protective trip functions. The DMS shall be supplied with the manufacturer's standard software, which shall be capable of adequately representing all of the functions described herein.

b. *Conventional Metering System (CMS)*

The CMS shall consist of current transformers, voltage transformers, meters, and switches as shown on the Contract Drawings, and as described below.

(1) Instruments and meters shall be of the semi-flush switchboard type, with rectangular dust-proof enclosing cases and anti-glare glass.

(2) Indicating instruments shall be 4-1/2 inches in diameter and have white dials with black marking, scales approximately 250 degrees and 7 inches in length, accuracy within plus or minus 1 percent of full scale, and external zero adjustment.

(3) Kilowatt-hour and kilowatt demand meters shall be of the integrating type and shall be draw-out type, with provision for testing, and shall be equipped with potential indicating lights.

O. Relays, Control Switches and Fuses

1. Protective relays, as shown on the Contract Drawings, shall conform to ANSI C 3 7.90 and be of the semi-flush mounted, removable type, with built-in test facilities. Current transformer secondaries shall be automatically short-circuited when the relay is removed from its case. Auxiliary relays shall be surface mounted and front connected, and shall be as specified on the Contract Drawings.

2. Protective relay ranges and types shall be as shown on the Contract Drawings.

3. Lockout relays shall be hand-resettable, panel mounted, with mechanical target on the escutcheon plate for indication of relay position. The contacts rating shall be 20 Ampere continuous. The relay shall be enclosed with a dust cover.

4. Control, transfer, and instrument switches shall be of the heavy duty rotary, multi-position, cam operated, multi-stage type, with dust cover, rated 600VAC, with silver to silver contacts rated for continuous current of 20 amperes. Each circuit breaker control switch shall have red and green target. Each switch shall be equipped with engraved plastic escutcheon or nameplate identifying its function and position. Handle styles shall be pistol grip for control, and oval for instrument or transfer switches.

5. Each Low Voltage Air Circuit Breaker shall be provided with a control switch on the door of each circuit breaker cubicle for performing breaker close and open operations. Mechanical red/green targets shall be incorporated in the switch to indicate breaker "Closed/Open" position. A spring-return mechanism shall return the switch handle to the normal vertical position.

P. Indicating Lamps

Indicating lamps shall be light emitting diodes (LED) of the low voltage, low burden series resistor type, with lens colors as approved by the Engineer. Lamps shall be replaceable from the front of the panel.

Q. Terminal Blocks

Terminal blocks for all external control connections shall be 600 volt, barrier type, having a minimum rating of 20 amperes with identifying marker strips. Terminal strips in each cubicle, shall have at least 20 percent spare terminals and shall be in accordance with NEMA ICS 4. Terminal blocks for current transformer secondary connections shall be of the short circuiting type.

R. Nameplates and Mimic Bus

1. Nameplates shall be provided for each switchgear, for each cubicle, and for all externally and internally mounted devices, including, but not limited to, instruments, meters, control switches, and relays to identify its function, and where applicable, its position.

2. Nameplates shall consist of letters and numbers back engraved on a laminated thermosetting plastic material, providing white letters and numbers on a black background. Size of letters and figures shall be approximately 1/8 inch for device nameplates and 7/16 inch for cubicle nameplates, and 1 inch for switchgear designations.

3. Nameplates shall be fastened with two oval-head stainless steel machine screws.

4. Number, location and designation of nameplates shall be as approved by the Engineer.

5. Mimic bus shall be provided on the face of the switchgear representing actual bus arrangements within the switchgear assembly. Circuit breaker control switches and indicating lights shall be located in the proper position on the mimic bus. The mimic bus shall be 1/8 x 3/4 inch, high strength thermosetting plastic material, secured every twelve (12) inches with self tapping screws.

2.04 SHOP PAINTING

A. Prior to assembly and before shop painting, all surfaces of the switchgear enclosure shall be thoroughly cleaned of rust, oil, grease, dirt and mill scale and receive a phosphatizing treatment, and then be primered with one coat of rust-inhibitor for a dry film thickness of 1-2 mils.

B. The exterior and interior of the switchgear shall be given two or more finish coats of corrosion resistant paint for a final dry film thickness of at least 2-4 mils. The color of the finish on the switchgear shall be ANSI number 61 light gray.

C. Alternative painting process, such as electrostatically applied paint, can be utilized, subject to the approval of the Engineer.

2.05 FACTORY TESTING

A. The switchgear shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchgear shall be tested to assure the accuracy of the wiring, and the functioning of all the equipment.

B. All switchgear components shall be tested in accordance with the Production Test outlined in ANSI C 37.20.1, C 37.50, and C 37.51 and shall include but not be limited to the following:

1. Dielectric Tests
2. Mechanical Operation Tests
3. Grounding of Instrument Transformer Cases Tests
4. Electrical Operation and Control Wiring Tests

C. Factory tests, shall be witnessed by the Engineer. The manufacturer shall notify the Engineer two (2) weeks prior to the date the tests are to be performed.

PART 3. EXECUTION

3.01 FIELD SUPERVISION

Provide the services of a qualified, factory-trained switchgear manufacturer's representative to provide technical field support in the installation and start-up of the equipment specified in this Section for a period shown on the Contract Drawings. The manufacturer's representative shall provide technical direction and assistance in general assembly of the equipment, connections, calibrations, adjustments, and testing of the assembly and components contained therein.

3.02 EXAMINATION

The Contractor is responsible for notifying the Engineer as soon as he finds conditions that prevent the proper installation of materials or methods specified in this Section.

3.03 INSTALLATION

A. Switchgear shall be transported within the construction site, unloaded, uncrated, installed, including assembly of all component parts, and wired in accordance with the manufacturer's instructions and recommendations and the requirements specified herein.

B. Provide all equipment, supervision, labor, rigging, tools, including, but not limited to, special equipment such as cranes.

C. Before setting the switchgear, the floor members and openings for conduits and bus entrances shall be checked for accuracy of position.

D. Switchgear shall be set on foundations at the locations shown on the Contract Drawings. Provide floor sills, and set level in concrete. Follow the manufacturer's recommendations for preparation of the mounting surface and the fastening of the equipment. The switchgear shall be set, aligned, and leveled in place using shims, where necessary, and shipping sections bolted together.

E. Bus splices shall be cleaned and bolted together and insulated either by taping or by use of insulating boots, if provided for that purpose.

F. The removable circuit breakers shall be installed in the housings and the rails adjusted, if required, for smooth travel of the circuit breakers. Main and secondary contacts on the removal and stationary sides shall be checked for tightness and adjusted if loose. Covers or enclosures shall be securely bolted in place.

G. After each item of equipment is installed and connected, the Contractor shall make a thorough inspection of the installation, cleaning all insulators that are exposed, and cleaning all cubicles and compartments of debris and foreign matter. Prior to final completion of the Work and field testing, the Contractor shall clean the equipment of all construction dust and dirt.

H. The Contractor shall complete all internal and external power and control connections.

I. All damaged paint areas shall be properly prepared by the Contractor for an application of primer and finish coats of paint, which shall be supplied by the manufacturer for this purpose. The Contractor shall apply the primer and finish paint coats.

3.04 FIELD TESTS

A. General

1. Field tests shall be performed in accordance with the manufacturer's recommendations, International Electrical Testing Association (NETA), NEMA, UL, ANSI, and as required in this Section and/or as directed by the Engineer.

2. All Work shall be performed with due regard for the protection of personnel and equipment. The Contractor shall provide protection to all personnel during performance of the tests.

3. Tests shall be performed only after equipment has been thoroughly cleaned.

4. All field tests shall be conducted in the presence of the Engineer for the purpose of demonstrating that the equipment and systems comply with the requirements of this Section to assure the Engineer that the entire installation meets applicable codes and standards requirements, and that all systems will function as designed.

5. All controls shall be checked individually by the Contractor prior to operational tests. Wiring diagrams and manufacturer's drawings shall be marked by the Contractor during checkout. Checked items shall be marked in yellow; discrepancies shall be corrected, and modifications shall be recorded in red. Marked wiring diagrams and manufacturer's drawings shall be submitted to the Engineer.

6. Record all test values, settings, and calibrations made by the Contractor and furnish the Engineer with copies of test reports after completion of each individual test. These reports shall include a description of the test procedures. The Contractor shall record all test data for each test required in this Section on test forms.

7. Advise the Engineer, in writing, upon failure of any equipment or material to pass the tests performed or to properly function as intended. The Contractor shall provide all necessary corrective action to render the equipment operational and acceptable.

B. Integrity Tests

The switchgear shall successfully complete the following tests as recommended by NETA and listed under the "Switchgear and Switchboard Assemblies" Section:

1. Visual and Mechanical Inspection

a. Inspect for physical, electrical, and mechanical condition.

b. Compare equipment nameplate information with latest one-line diagram and report discrepancies.

c. Check for proper anchorage, required clearances, physical damage, and proper alignment.

d. Inspect all doors, panels, and sections for paint, debris, scratches, fit, and missing hardware.

e. Verify that fuse and/or circuit breaker sizes and types correspond to the Contract Drawings.

f. Verify that current and voltage transformer ratios correspond to the Contract Drawings.

g. Inspect all bus connections for high resistance. Use low-resistance ohmmeter, or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.

h. Test all electrical and mechanical interlock systems for proper operation and sequencing.

(1) Closure attempt shall be made on locked open devices. Opening attempt shall be made on locked close devices.

(2) Key exchange shall be made with devices operating in off-normal positions.

i. Clean entire switchgear using manufacturer's approved methods and materials.

j. Inspect insulation for evidence of physical damage or contaminated surfaces.

k. Verify proper barrier and shutter installation and operation.

l. Lubrication

(1) Verify appropriate contact lubricant on moving current carrying parts.

(2) Verify appropriate lubrication on moving and sliding surfaces.

m. Exercise all active components.

n. Inspect all mechanical indicating devices for proper operation.

2. Electrical Tests

a. Perform tests on all instrument transformers in accordance with NETA published values.

b. Perform ground-resistance tests in accordance with NETA published values.

c. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground for one (1) minute. Test voltages and minimum resistances shall be in accordance with NETA published values.

d. Perform an overpotential test on each bus section, each phase-to-ground, for one (1) minute at values recommended by the manufacturer.

e. Perform insulation-resistance test on shipping split control wiring. Do not perform this test on wiring connected to solid-state components.

f. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.

g. Perform secondary voltage energization test on all control power circuits and voltage tests as detailed below in paragraph k, and l.. Check voltage levels at each point on terminal boards and at each terminal device.

h. Perform current injection test on entire current circuit in each section of switchgear.

(1) Perform current tests by primary injection, where possible, with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit.

(2) Where primary injection is impractical, utilize secondary injection with a minimum of 1.0 ampere.

(3) Test current at each device.

i. Determine accuracy of all meters and calibrate watt-hour meters per NETA recommendations. Verify multipliers.

j. Perform phasing check on double-ended switchgear to ensure proper bus phasing from each source.

k. Control Power Transformers - Dry Type

(1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

(2) Verify proper primary and secondary fuse ratings or circuit breakers.

(3) Verify proper interlock function and contact operation.

(4) Perform insulation-resistance tests. Perform measurements from winding-to-winding and winding-to-ground. Test voltages and minimum resistances shall be in accordance with NETA published values. Results shall be temperature corrected in accordance with NETA published values.

(5) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.

(6) Verify proper secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

l. Potential Transformer Circuits

(1) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.

(2) Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

C. Records of Tests

1. Types of Records

Maintain complete and accurate records of all tests. These records shall include the following:

a. Description of test equipment used, including serial numbers.

b. Equipment or circuit identification, description, and location.

c. Complete nameplate data, including serial number.

d. Readings and measurements taken, including temperature and humidity.

e. Description of test, including date and tester's signature.

f. Test results (written description as required).

g. Other observable data applicable to equipment tests.

h. Description of any necessary corrective actions.

i. Certification of satisfactory completion of wiring and installation in accordance with applicable items of this Section.

3.05 PROTECTION

Protect switchgear, equipment, and facilities against damage, mechanical or otherwise and provide maintenance until issuance of the Certificate of Final Completion. The switchgear and equipment shall be kept clean, dry, and protected at all times.

3.06 TRAINING

A. Provide at the construction site training sessions for the number of Authority personnel, as specified on the Contract Drawings, for two (2), eight (8)-hour days.

B. The training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

C. For additional training time requirements, see Section 16000 of these specifications.

END OF SECTION

SECTION 16335

LOW VOLTAGE SWITCHGEAR

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16335A01 Shop Drawings

a. Legend, Abbreviations, General Notes, and Drawing List
b. Outline drawings indicating overall dimensions, shipping sections, weights, and aisle space requirement for removable equipment
c. Switchgear rigging and installation drawings including anchoring details, locations of sills, and anchor bolts
d. Elementary diagrams (terminal configuration) for removable circuit breakers, relays, control switches, and meters
e. Structural drawings showing available space for busway, conduit, and cable connections
f. Bus arrangement including dimensions and ampere rating of all bus bars
g. Bill of materials for all equipment including item description, rating, and location
h. One line diagram showing all ratings, main connections, and location of all instruments including relays, transformers, and meters
i. Three line diagrams showing all instrument connections including relays transformers and meters
j. Kirk key interlock diagram with functional description
k. Removable circuit breaker's elementary diagrams
l. Front view of each vertical section showing all panel mounted equipment
m. Front view of all internal panels of each cubicle showing all control devices such as relays
n. Complete point to point wiring diagrams or schedules indicating the internal wiring of each component and the interconnections between components
o. Nameplate schedule and details
p. List special tools required for operation and maintenance of all equipment

Catalog Cuts

16335B01 Catalog Cuts

a. Relays
b. Control switches
c. Indicating lamps
d. Control wiring
e. Wire markers

f. Terminal blocks
g. Switchgear space heaters
h. Thermostats
i. Bus insulation materials
j. All types of lugs
k. All types of fuses and circuit breakers
l. Family of time current characteristics curves for all types of fuses, relays, and trip devices
m. Instrument transformer characteristic curves and burden
n. Conventional metering system (CMS) devices
o. Digital Metering System (DMS) hardware and software

Manufacturer Test Reports

16335F01 Test Reports
a. Submit factory tests and field tests forms for approval prior to implementation of the tests.
b. Submit certified test reports for tests specified in 2.05 and 3.03 of this section.
c. Submit Seismic Certification.
d. Submit certified test report for paint qualification test performed per ANSI C 37.20.1.

Manuals, Warrantees/Guarantees

16335I01 Operation and Maintenance Manuals
a. Maintenance documentation, including manuals, shall include descriptive material that will enable the Authority to maintain a supplied equipment at the component level. The document shall provide guidelines for isolating the cause of malfunction and for the removal, repair, and replacement of all devices.
b. Each manual, in addition to the information described above, shall contain the following:
1. Calibration data, curves, wiring diagrams, and other pertinent information for all components provided
2. Operational procedure, both manual and automatic
3. Recommended preventive maintenance schedules

Spare Parts List

16335N01 Spare Parts List
Furnish a list of recommended spare parts, the list shall contain the prices and availability. Recommendation for spare parts shall not obligate the Authority to purchase any such parts.

END OF APPENDIX "A"

DIVISION 16

SECTION 16390

ELECTRICAL POWER SYSTEM STUDIES

PART 1. GENERAL

1.01 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 16000 - General Electrical Provisions.

1.02 GENERAL REQUIRMENTS

A. The electrical equipment manufacturer, or a professional engineer registered in the State of New Jersey and New York, shall provide electrical power system studies for the project job. The type and content of each study is specified in the following sections

1.03 SHORT CIRCUIT ANALYSIS

A. Calculation of the maximum rms symmetrical three-phase short-circuit current at each significant location (switchgear, substation, MCC, distribution panelboard, panelboard, etc.) in the electrical system shall be made using a digital computer.

B. Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment shall be subjected to under fault conditions.

C. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.

D. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

E. Include a bus-to-bus computer printout identifying the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus-to-bus calculation.

F. The system one-line diagram shall be computer generated and shall clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.

G. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

H. Any changes to engineering documents as a result of short circuit analysis shall not result in any additional cost to the Authority.

I. The Contract shall be responsible for supplying conductor information (lengths, types, number per phase, etc.) in a timely manner to allow the short-circuit analysis to be completed prior to final installation.

J. Any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements as soon as any they are identified.

K. Any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements as soon as any they are identified.

1.04 ARC FLASH ANALYSIS

A. Calculation of the maximum available arc flash energy at each significant location (switchgear, substation, MCC, transformer, distribution panelboard, panelboard) to be made using both NFPA 70E and IEEE 1584 calculations for the range of short circuit utility current available per ACE requirements.

B. A tabular printout shall be included which lists the highest available arc flash energy in cal/cm^2, the voltage, butted short-circuit current available, flash boundary, working distance, protective device cleaning time and protective equipment category.

C. Tabulated report shall clearly indicate which calculation method is used and whether calculations are within the valid range parameters set out in IEEE 1584 and NFPA 70E.

D. A comprehensive single-line diagram indicating the arc flash energy (max) at each point in the system shall be included with the tabular report.

E. A comprehensive discussion section, evaluating the possibility and ramifications of reducing the arc flash at high arc-flash points (where calculated values exceed the ratings in NFPA 70E Table 130.3(9)).

F. Provide two (2) bound copies of the completed arc-flash analysis, along with the short-circuit study, to the Construction Manager Engineer.

G. Provide Arc Flash Warning Labels as follows:

1. Provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
2. The label shall have an orange header with the wording, **"WARNING - ARC FLASH HAZARD"** and shall include the following information:
   a. Location designation.
   b. Nominal voltage.
   c. Flash protection boundary.
   d. Hazard/risk category.
   e. Incident energy.
   f. Working distance.
   g. Engineering report number, revision and issue date.
3. Labels shall be machine printed with no field markings.
4. Labels shall be field-installed at the time of start-up and testing by the engineering field service division of the company providing the arc flash analysis.

H. Training:

1. Train Authority's personnel for a minimum of 4 hours on the potential hazards associated with working on energized equipment. Maintenance procedures in accordance with NFPA 70E shall be provided in the equipment manuals. All training shall be certified for containing education units (CEO's) by IACET.

1.05 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. The time-current coordination analysis shall be performed with the aid of a digital computer and shall include the determination of settings, ratings, or types for the overcurrent protective devices supplied.

B. Selective coordination shall be performed per NEC Article 700 requirements.

C. Where necessary, an appropriate compromise shall be made between system protection and service continuity with service continuity considered more important than system protection.

D. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of overcurrent devices and other pertinent system parameters.

E. Computer printouts shall accompany the log-log plots and shall contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

F. The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices, the equipment where the device is located, the device number corresponding to the device on the system one-line diagram, and the number of the time-current log-log graphs where they are illustrated.

G. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

H. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for increasing system protection or device coordination. Submit curves and study as a shop drawing for approval.

I. Significant deficiencies in protection and/or coordination shall be called to the attention of the Engineer and recommendations made for improvements as soon as any they are identified.

J. Factory set all relays, breaker trips, and select proper HV fuses which coordinate with transformer in rush current and circuit breakers.

K. Include in study the emergency generator main breaker and associated distribution system.

L. Preliminary coordination study shall be made by Vendor prior to submission of shop drawings.

M. Sizes of fuses, breaker interrupting rating, bus bracing shall be minimum as shown on drawing. Exact sizing shall be according to coordination study.

N. Any changes to engineering documents, as a result of coordination study shall not result in any additional cost to the Authority.

O. The Vendor shall contact the Engineer immediately if any delay occurs due to the lack of required information he needs to complete this study.

P. If any delay occurs due to time required for manufacturing of the indoor switchgear submit shop drawings on this switchgear prior to coordination study shop drawings.

Q. Present organized time-current analysis of each protective device in series from main circuit breaker in branch circuit panelboard back to Utility Company devices protective service, including on-site service, main and federal circuit protective devices.

R. Provide two (2) bound copies of the completed protective device time-current coordination analysis to the Engineer.

1.06 LOAD FLOW AND VOLTAGE DROP ANALYSIS

A. The Load Flow and Voltage Drop Analysis shall be made using a digital computer and include calculations of power flow in all three-phase branch and feeder circuits, calculated voltages at each bus and voltage drops of each feeder.

B. The analysis shall provide the calculated maximum values of kVA, kW, kVAR, power factor, and amperes for each power circuit.

C. The calculated power losses in each branch and total system losses shall be provided.

D. A computer printout listing all cables, transformers, loads, and other circuit data shall be included.

E. Provide tabular bus-to-bus computer printouts listing the calculated values.

F. The analysis shall include a computer generated system one-line diagram clearly identifying individual equipment buses, bus numbers, cable and bus connections, power flow throughout the system, and other information related to the analysis.

G. A discussion section evaluating the loading and voltage levels for the system shall be provided and recommendations included as appropriate to improve system operation.

H. Significant deficiencies in loading or voltage levels shall be called to attention of the Engineer and recommendations made for improvements as soon as they are identified.

I. Provide two (2) bound copies of the completed Load Flow and Voltage Drop Analysis to the Engineer.

1.07 POWER FACTOR CORRECTION STUDY

A. A Power Factor Correction Study shall be performed to determine the appropriate level of compensation needed to achieve the desired power factor.

B. Impacts on harmonic and transient concerns shall be evaluated in order to determine the optimum size and configuration of the equipment.

C. The study shall make appropriate recommendations in order to provide proper operation of the electrical system.

D. The study shall be based on load data collected from on-site measurements in order to characterize the power factor of the system over a period of time and under varying load conditions.

E. System loading tables shall be provided which include power factor data and estimated levels of power factor compensation provided.

F. Evaluation of system operation using the estimated levels of compensation shall be provided with consideration to harmonic and transient concerns.

G. Final levels of compensation shall be determined and used as the base case condition for the harmonic and transient studies.

H. All conclusions, recommendations, and equipment specifications as a result of the Power Factor Correction Study shall be summarized in the final report.

I. Provide two (2) bound copies of the completed Power Factor Correction Study shall be provided to the Engineer.

1.08 HARMONIC ANALYSIS STUDY

A. A Harmonic Analysis Study shall be made to determine the levels of harmonic voltages and currents in the system.

B. The type and level of compensation needed to achieve the desired power factor and acceptable levels of harmonics shall be considered.

C. Transient concerns shall be evaluated in order to determine the optimum equipment size, location in the system, and configuration.

D. The study shall make appropriate recommendations in order to provide proper protection and operation of the electrical system.

E. The study shall be based on load data collected from on-site measurements in order to characterize the power factor of the system over a period of time and under varying load conditions.

F. Harmonic measurements shall be performed in order to provide nonlinear load (eg. dc drive) characteristics, voltage distortion levels, and model verification. The measurements shall be conducted over a 1-5 day period.

G. Harmonic source models shall be developed for each nonlinear load (drive, etc.) type. The load characteristics shall be determined by measurement and used as harmonic sources for the computer simulations.

H. Frequency scan cases (impedance vs frequency) shall be completed in order to determine the system frequency response characteristic for various system conditions.

I. If required, the application of harmonic filters shall be evaluated to determine the optimum filter size and configurations.

J. Computer simulations shall be performed to determine the system harmonic voltage and current levels and voltage distortion levels (and compared with measured values to determine the effect of various system conditions).

K. If required, harmonic filter specifications shall be developed with consideration to cost, filtering options, and effectiveness of harmonic filters.

L. Provide two (2) bound copies of the completed Harmonic Analysis Study to the Engineer.

1.09 SWITCHING TRANSIENT ANALYSIS STUDY

A. A Switching Transient Analysis Study shall be made to determine the transient overvoltages for various switching conditions and their effect on the operation of the electrical system.

B. Various system conditions (consistent with previously gathered data from the Power Factor Correction Study and Harmonic Analysis Study) shall be evaluated so that the proper overvoltage protection specifications may be developed.

C. Transient simulations shall be performed using a digital computer in order to determine transient voltage levels at the low voltage buses within the electrical system.

D. The electrical system parameters shall be varied to in order to determine their effect on the transient voltages.

E. Various solutions to excessive transient voltage levels shall be considered and additional computer simulations made to determine their validity.

F. The evaluation must consider solutions to power factor and harmonic concerns with respect to transient overvoltage levels.

G. Nuisance tripping of electronic power equipment (eg. adjustable speed drives) shall be evaluated and corrective or preventive techniques suggested.

H. Provide two (2) bound copies of the completed Transient Analysis Study to the Construction Manger.

1.10 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

Not Used

PART 3. EXECUTION

Not Used

END OF SECTION

SECTION 16390

ELECTRICAL POWER SYSTEM STUDIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS:

A. Submit in advance, to the Engineer, for approval, the qualifications of the Professional Engineer specified in 1.02 A.

B. Submit six bound copies of each study specified in 1.03, 1.04, 1.05, 1.06, 1.07, 1.08, and 1.09. Submit revised copies of the studies as requested by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16450

GROUNDING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for grounding.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	Administrative Code
	Electrical Code of the City of New York
	American National Standards Institute (ANSI)
ANSI C 2	National Electrical Safety Code
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE Std 142-1991	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE Std 1100-1992	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
	National Fire Protection Agency (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 467	Grounding and Bonding Equipment

1.03 QUALITY ASSURANCE

A. Components and installation shall comply with NFPA 70, "National Electric Code."

B. Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in NFPA 70 Article 100.

1.04 SUBMITTALS

See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

2.01 GENERAL

Furnish grounding elements for switchgear, transformers, cabinets panelboards, starters, and miscellaneous electrical equipment, for all non-current-carrying metallic portions of the entire electrical system and for exposed non-electrical systems located in electrical substations or switchgear rooms as required by ANSI C 2, NFPA 70, and building codes which would be applicable, if the Authority were a private corporation.

2.02 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide grounding products of manufacturers as shown on the Contract Drawings.

2.03 GROUND RODS

Ground rods shall be copper clad steel. Unless otherwise shown on the Contract Drawings, the rods shall be 3/4-inch diameter by 10 feet long.

2.04 GROUNDING CONDUCTORS

A. Provide grounding conductors in accordance with the requirements of NFPA 70, Sections entitled "WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)," "WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE)," and "TAXIWAY/RUNWAY WIRES AND CABLES," as applicable, and as specified on the Contract Drawings.

B. Equipment grounding conductors shall be green insulated.

C. Isolated grounding conductors shall be green insulated with yellow striping.

2.05 ABOVE GRADE CONNECTIONS

Connectors to piping, fencing, and conduit systems shall be listed and labeled as grounding connectors for the materials used.

2.06 BELOW GRADE CONNECTIONS

Buried Cable and ground rod connections shall be exothermic welds. Welded connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors shown on the Contract Drawings.

2.07 GROUNDING BUSHINGS

Grounding Bushing shall be insulated type.

2.08 LIGHTNING PROTECTION COMPONENTS

Lightning protection components shall be provided as specified in Section entitled "LIGHTNING PROTECTION SYSTEM."

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Install grounding elements for switchgear, transformers, cabinets, panelboards, starters, and miscellaneous electrical equipment, for all metallic non-current carrying portions of the entire electrical system and for exposed non-electrical systems located in electrical substations or switchgear rooms as required by ANSI C 2, NFPA 70 and building codes which would be applicable, if the Authority were a private corporation.

B. Install grounding as shown on the Contract Drawings.

C. Grounding and bonding equipment for use in connection with interior wiring systems shall conform to UL 467.

D. Install separate insulated equipment grounding conductors with circuit conductors to maintain grounding system at equipotential. Raceway system shall not be utilized as the equipment ground.

E. Connect exposed metallic piping or ductwork of any non-electrical system that is located in an electric substation or switchgear room, to ground in the room. Where the run through the room exceeds 15 feet in length, make ground connections at both the entering and leaving points of the piping or ductwork.

F. Ground all non-current-carrying metallic enclosures of electrical conductors, or exposed non-current-carrying metallic parts of electrical equipment, or of power apparatus.

G. Connections:

1. General

   Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

2. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

3. Make connections with clean bare metal at points of contact.

4. Make all connections of grounding connector cables to ground rods by exothermic welding method. Welds that are puffed up, or that show convex surfaces indicating improper cleaning are not acceptable.

5. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

6. Tighten grounding and bonding conductors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts.

7. Where insulated grounding conductors are connected to ground rods, or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

H. All sensitive electronic equipment including computers and other components specified on the Contract Drawings, shall be connected to an isolated grounding system. The isolated grounding system shall be installed as specified on the Contract Drawings. The isolated grounding system and the electrical power equipment grounding system must be connected together at a single point, as shown on the Contract Drawings and in accordance with the requirements of NFPA 70, and all applicable local codes. Utilization of a grounding electrode separate from, and not connected to, the electrical power equipment grounding system is not acceptable

I. All ground rods in grounding loops shall have less than 5 ohms resistance to ground. All individual or isolated ground rods shall have a maximum of 25 ohms resistance to ground. The maximum overall grounding system resistance to ground shall be as shown on the Contract Drawings.

3.02 FIELD TESTS

Make ground resistance tests at all ground rods to verify that grounding system is at equipotential and to ensure compliance with the requirements specified in 3.01 I above, in the presence of the Engineer, and prepare all test results in tabulated form indicating location and time of each test and soil resistivity measured. If ground resistance on a grounding resistance test is higher than the value specified in 3.01 I, either increase the length of the rod or add more rods to the grounding system until the required ground resistance is achieved.

END OF SECTION

SECTION 16450

GROUNDING

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts for ground rods, connectors and connection materials, and grounding fittings.

B. Ground Resistance Test Results.

END OF APPENDIX "A"

DIVISION 16

SECTION 16452

ELECTRICAL BONDING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for furnishing, installing and testing an electrical bonding system for corrosion control/stray current mitigation on all underground structures.

1.02 REFERENCES

	American Society for Testing and Materials (ASTM)
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
	Military Specifications (MIL)
MIL A-18001	Anode, Corrosion Preventative Zinc, Slab, Disk and Rod Shapes
	National Association of Corrosion Engineers (NACE)
NACE RP 0169	Control of External Erosion on Underground or Submerged Metallic Pipe Systems

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The Electrical Bonding System shall be designed, manufactured and installed in accordance with the latest revision of applicable standards ASTM, MIL and NACE. In case of conflict between various standards, the more stringent requirement shall apply.

1.04 QUALITY ASSURANCE

A. The Contractor shall provide the Electrical Bonding System design, certified by a NACE accredited Corrosion Engineer, licensed as a Professional Engineer in the state in which the work is to be performed, and experienced in corrosion control procedures. Submit the qualifications of the Corrosion Specialist, for review by the Engineer.

B. Electrical bonding devices, of type and sizes required, shall have been satisfactory used for the purposes similar to those herein, for not less than three years.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store materials in original packaging in a manner to prevent soiling, damage, wetting or corrosion prior to installation.

B. Handle in a manner to prevent damage to finished surfaces.

C. Where possible, maintain protective coverings until installation is complete and remove such covers as part of final cleanup.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide electrical bonding materials and equipment of the manufacturers listed on the Contract Drawings.

2.02 MATERIALS

A. Electrical Bonding Devices

Unless otherwise shown on the Contract Drawings, furnish materials and products in accordance with the following requirements:

1. Cables shall be stranded copper, #8 AWG minimum, conforming to ASTM B 3 and B 8; insulated with 0.11 inches of high molecular weight polyethylene.

2. Zinc Reference Electrode shall conform to the requirements of MIL A-18001, 1-1/4 inches by 1-1/4 inches by 9 inches long, 5 pound, 1/4" dia. steel core package electrode, and in accordance with the following requirements:

   a. Lead wire shall comply with 2.02.A.1, and shall be factory connected to the anode center with the connection sealed in cast epoxy resin encapsulation.

   b. Electrode shall be packaged in a permeable package cloth sack, total weight as recommended by the manufacturer, containing compacted backfill of mixture with the following requirements:

Material	Percent
Hydrated Gypsum	50
Bentonite	50

   c. Epoxy resin encapsulation shall be two-piece, snap-together molded bodies, sized for cable, with two-part low viscosity polyurethane insulating and sealing compound, rated for 600 volts.

B. Buried cable and ground rod connection shall be exothermic welded.

C. Junction boxes shall be in accordance with Section 16135, entitled "BOXES AND FITTINGS".

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related work satisfy the requirements for performance of the work for this Section in accordance with the Contract Documents.

B. Report immediately to the Engineer any electrical, structural or related construction defects in areas where bonding devices are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

C. Provide control and inspection of all exothermic bonding connections before casting them in concrete and for proper electrical connections of all underground structural members.

3.02 PREPARATION

Before installation of electrical bonding devices, the Contractor shall investigate the site condition to determine, what preparatory work, if any, will be needed.

3.03 INSTALLATION

A. General

1. Install electrical bonding devices in accordance with approved printed manufacturer's installation procedures, and as specified.

2. Coordinate with other trades, to electrically bond all structural steel and reinforcing bars, embedded in the concrete below grade. Bonding shall be completed in closed circuit to minimize corrosion activity, and shall conform to the Corrosion Specialist design.

B. Bonding Connections

1. Bond bare or uncoated reinforcing steel using single insulated conductors or straps, exothermically welded to steel beams.

2. Cross bond all bare or reinforcing steel, using exothermic welds.

3. Make welds in accordance with manufacturer's requirements.

C. Conductors

1. Use continuous, insulated conductors, without splices, between welded connections.

2. At the end of line of bonded steel beams, connect the insulated header cable, using exothermic welds, and terminate this cable inside the test junction box as shown on Contract Drawings. Where structural beams or steel members are coated, clean and coat with coal tar epoxy after completion and cooling of welded area.

D. Test Electrode Wells and Junction Boxes

1. Bury electrodes of type and at locations shown on the Contract Drawings. Excavate and backfill holes in accordance with the manufacturer's written instructions and in accordance with the following requirements:

   a. Wet packaged electrode thoroughly before backfilling the hole.

   b. Use fine clay soil, free from stones and bricks, for backfilling.

2. Install header cables of size, and at location shown on the Contract Drawings.

3. Install test junction box of type, and at locations, shown on the Contract Drawings in accordance with Section 16135 entitled "BOXES AND FITTINGS".

4. Run electrode lead wires to test junction boxes as shown on the Contract Drawings.

5. Install size and type of conduit shown on the Contract Drawings, in accordance with the requirements of Section 16110 entitled "RACEWAYS".

6. Install cable, leaving slack in test junction boxes.

7. Use exothermic welds, sealed with cast epoxy resin encapsulation, for splices made in direct buried cable.

E. Identification

Identify all cables, in each test junction box, using fiber tags (1/16 inch thick and 3/4 inches wide) intended with letters and numbers 5/16 inch high, fastened to cables with #14 AWG weatherproof copper wire.

F. Field Tests

Test that materials are installed and connected as shown on the Contract Drawings, and as required by the Corrosion Specialist's certified design.

1. Test the complete Electrical Bonding System to ensure electrical continuity. The tests must show that the elements of the structure are electrically bonded and prepared for connection to the test box.

2. Testing shall be in accordance with NACE RP 0169 requirements.

3. All test data shall be included in a final report, prepared by the Corrosion Specialist, indicating the initial conditions, with a listing of further recommendations pertaining to the maintenance and periodic testing of the system(s).

4. The Contractor shall correct any deficiencies discovered during the tests.

END OF SECTION

SECTION 16452

BONDING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16452A01 Shop Drawings
a. Details of bonding of structural steel and reinforcing bars encased in concrete below grade
b. Steel and concrete shop drawings, including all required welds, bonding connections and recoating or patching of protective coatings
c. Layout drawings of test electrodes, cabling and test junction boxes

Certificates

16452E01 The Electrical Bonding System design, certified by a NACE accredited Corrosion Specialist, licensed as a Professional Engineer in the state in which the work to be performed.

Qualifications

16452K01 Submit qualifications of the Corrosion Specialist and a copy of NACE certificate.

Record Documents

16452M01 Submit 12 copies of all test data, and the final report.

END OF APPENDIX "A"

DIVISION 16

SECTION 16470

PANELBOARDS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for electrical panelboards and cabinets.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA PB 1	Panelboard
NEMA PB 1.1	General instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
NEMA PB 250	Enclosures for Electrical Equipment (1000 Volts maximum)
NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches
NEMA AB 3	Molded case Circuit Breakers and Their Application
NEMA 280	Application Guide for Ground Fault Circuit Interrupters
NEMA AB 4	Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications
NEMA Z535.4	Product Safety Signs and Labels
	National Fire Protection Association (NFPA)
NFPA 70	National Electric Code
	Underwriters Laboratories Inc. (UL)
ANSI/UL 67	Panelboards
ANSI/ UL 50	Cabinets and Boxes
UL 1059	Electrical Terminal Blocks
ANSI/UL 65	Electric Wired Cabinets
ANSI/ UL 486E	Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use With Copper Conductors

ANSI/UL 969	Marking and Labeling systems
ANSI/UL 467	Electrical Grounding and Bonding Equipment
ANSI/UL 437	Key Locks

Federal Specifications

Panelboards, W-P-115a,c

Type 1 - Circuit Breaker Equipped

Class 1- Panelboards

Class 2 - Load Centers

Molded Case Circuit Breakers, W-C-375a,b

Fusible Switches, W-S-865c

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Panelboards shall be designed in accordance with applicable standards of ANSI, NEMA, NFPA and UL. A list of acceptable manufacturers is shown on the Contract Drawings.

B. Unless otherwise shown on the Contract Drawings, Panelboard cabinets shall meet the following environmental requirements:

1. Cabinets located in heated areas shall be NEMA Type 1.

2. Cabinets located in unheated areas or in areas subject to dust or oil, shall be NEMA Type 12.

3. Cabinets located in exterior areas or locations subject to rain, dripping liquid, or hosing shall be NEMA Type 4X, stainless steel.

C. ANSI design test shall have been made on a prototype of each type of panelboard.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Panelboards shall be delivered to the construction site complete. All circuit breakers, other electrical devices, and accessories, shall be in place and wired.

B. Panelboards and accessories shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. Store components and devices in clean and dry space, protected from weather.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces.

1.05 SPARE PARTS AND TOOLS

A. One set of all special tools and wrenches required for assembly or disassembly of the panelboard and the installation of breakers shall be furnished.

B. Furnish a list of recommended spare parts for each panelboard. This list shall contain the prices and availability of the spare parts recommended.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 GENERAL

A. List of acceptable manufacturers is shown on contract drawings.

B. The size, rating, and number of circuit breaker in the panelboard shall be as shown on the Contract Drawings.

C. All panelboards, for which there are established UL standards, shall bear the UL label.

D. Location of panelboards and their approximate dimensions shall be as shown on the Contract Drawings.

E. Each panelboard shall be factory assembled, tested and shipped as a single complete unit, with all circuit breakers and buses installed, unless written permission is given by the Engineer to disassemble any parts for shipment.

2.02 CONSTRUCTION FEATURES

A. Panelboard interior

1. Panelboard interiors shall be designed and assembled so that individual breakers may be added, removed, or replaced without disturbing adjacent units and without removing main bus or brunch circuit connectors.

2. All parts shall be readily accessible and like parts shall be interchangeable insofar as possible.

3. Modifications and optional features such as silver plated copper bus, subfeed lugs, shunt trips, meters, etc., shall be as shown on the Contract Drawings.

B. Panelboard Enclosures (Cabinets)

1. The panelboard assembly shall be mounted in a galvanized steel or stainless steel enclosure (cabinets) as shown on the Contract Drawings. Cabinets and trims shall be surface-mounted or recessed installation as shown on the Contract Drawings.

2. Cabinets shall be arranged to provide side gutters 6 inches wide. Cabinets shall be provided with top and bottom gutters not less than 6 inches wide. For 400A or 600A mains, top and bottom gutters shall be 8 inches. Where feeder cables supplying the mains of a panelboard are carried through its box to other panelboards, the cabinet shall be provided with adequate additional side gutters space for the riser cable and taps.

3. The cabinet shall have a galvanized sheet-steel one-piece frame with a hinged door.

4. Recessed or flush-mounted cover frames shall extend 3/4 inch beyond each side of the cabinets and shall be set with their backs flush with the finished wall. Covers shall have adjustable trim clamps to compensate for misalignment and shall be completely concealed when door is closed.

5. Surface-mounted cover frames shall be sized to match the overall dimensions of the cabinet or flanged around to cover the edge of the cabinet.

6. Breakers and interior bus shall be covered by a removable framed trim, mounted inside the cabinet.

7. Doors shall close against a rabbet placed all around the inside edge of the frame, with a close-fitting joint between the door and frame

8. Doors shall be fitted with concealed, continuous, flush piano hinges.

9. Fastening screws on front panel shall be stainless steel and shall be of the captive, tamper proof type. Front panels shall not be removable with door in locked position.

10. Provide a metal frame with clear impact resistant plastic cover, mounted inside of each panelboard door to hold circuit directory.

C. Overcurrent protective devices and buses

1. Overcurrent protective devices shall be circuit breakers, fully rated, bolt on, thermal magnetic, inverse time delay, molded case. Breakers shall be 1, 2 or 3 pole with an integral crossbar or an internal common trip element, to assure simultaneous opening of all poles of a multi-pole circuit breaker. All circuit breakers shall meet requirements specified in the section of these Specifications entitled "OVERCURRENT PROTECTIVE DEVICES"

2. Connections of the branch circuits to the main bus shall be of the phase sequence type, that is, adjacent poles shall be of unlike polarity and rotated in sequence. This shall allow complete flexibility of circuit arrangement (1, 2 or 3 poles) to evenly balance the electrical load on each phase.

3. Main bus bars, including full capacity isolated neutral, shall have an ampere rating not less than that of the main breaker or lugs, and shall be braced for a momentary short circuit as specified on the Contract Drawings. The minimum short circuit rating shall be equal or be greater than the rating of the panelboard integrated equipment.

4. Buses shall be designed in such a manner that no machining, drilling, or tapping shall be required to change circuits or add new breakers.

5. All main and branch circuit bus shall be copper with a 1000 Amperes per square inch current density, and contact surfaces shall be silver plated and shall have no more than 200 Amperes per square inch current density.

6. A copper ground bus shall be furnished and installed by the panelboard manufacturer for equipment grounding. When shown on the Contract Drawings the Manufacturer shall install an isolated type grounding bus.

7. Main lugs shall be solderless, mechanical type and shall be secured in line with UL standards to prevent lugs from turning or loosening when incoming cables are installed.

8. Where circuit breakers with ground fault protection are shown on Contract Drawings, they shall be UL class A type and shall be identified on the panelboard.

9. Lighting fixture circuits controlled only by a circuit breaker shall each be identified by a 1 inch long by 3/4-inch high black laminated plastic nameplate with white letters.

10. Circuit breakers used for switching fluorescent lighting shall be rated and identified with a SWD tag.

2.03 ACCESSORIES

A. Nameplates

1. Provide approved nameplates on the front cover of each cabinet, indicating the panel name and number.

2. Unless otherwise shown on the Contract Drawings, fabricate nameplates from an approved type of lamacoid plastic with letters engraved on the plate in white on black background. Where letter sizes are not shown on the Contract drawings, use 1/2-inch high letters. Nomenclature shall comply with a schedule approved by the Engineer.

3. Secure nameplates on equipment with brass or stainless steel screws with locking hardware.

B. Panelboard cabinet locks

Each locked cabinet shall be furnished with a combination catch and flat lock with spring loaded type door pull. Locks shall be fitted to separate keying for each system. Furnish one key for each cabinet installed and a maximum of 20 keys per system.

C. Provide a typewritten directory identifying each brunch circuit as to the load which it serves, and install the directory in metal frame inside the panelboard door.

2.04 PAINTING

A. Surfaces to be painted shall be prepared by the removal of all grease, oil, rust, scale or other foreign material.

B. A prime coat of zinc chromate paint and two (2) finish coats of enamel paint conforming to ANSI Z 55.1 shall be applied. The gray prime and finish paints shall be a compatible finish system. In public areas the cabinets shall be painted as above, unless otherwise shown on Contract Drawings.

C. Furnish a can of touch-up paint for use after equipment is positioned.

D. Stainless steel panels shall not be painted. Galvanized panels shall be painted if shown on the Contract Drawings.

2.05 SHOP TESTS

A. Shop tests shall be in accordance with NEMA, ANSI and IEEE specifications.

B. During the period of shop drawing submission complete information outlining the test methods and procedures to be followed shall be submitted to the Engineer for approval. A copy of test forms and a set of sample computations to be used shall be furnished at the time.

C. The Engineer shall be permitted to inspect any equipment, material or work to be furnished under this specification and shall have the right to reject any parts considered defective, unsuitable for the purposes or not in accordance with these specifications.

D. The Engineer shall be notified at least two weeks before testing. This notification shall list type and number of units to be tested. The Engineer reserves the right to require additional testing or to waive factory inspection or witnessing of tests.

E. Five (5) certified copies of all test results shall be furnished to the Engineer. Certification shall be by a Professional Engineer licensed in the State in which the tests are performed, and stamped.

F. Circuit breakers shall be tested individually in the following sequence:

1. Calibration test
2. Overload performance test
3. Continuous current test.
4. Endurance performance test
5. Calibration test (repeated).
6. Determination of interrupting rating
7. Dielectric test

Results of tests on prototype circuit breakers of each size and type will be acceptable.

G. Panelboards shall be marked with their maximum short circuit rating at the supply voltage. The short circuit rating of each panelboard shall be determined after complete assembly. The short circuit tests on the breakers and panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The method of testing shall be in accordance with UL 67. The source shall be capable of supplying specified panelboard short circuit current or grater.

H. Release of equipment shall not relieve the Contractor of the responsibility of furnishing equipment conforming to all specification requirements.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documents.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 PREPARATION

A. Install any channels, angles or other supports that are required to support or mount the panelboards.

B. Use supports and fasteners as specified in the Section of the Specifications entitled "SUPPORTING DEVICES" or as shown on the Contract Drawings.

3.03 INSTALLATION

A. Surface and flush mounted panelboards shall be installed with tops 6 feet-6 inches above the floor, unless otherwise shown on the Contract Drawings.

B. Panelboards shall be installed true and plumb on supporting struts and shall not be mounted directly on concrete, concrete block walls, or any other walls subject to moisture. Leave a minimum gap of 1/2 inch between the back of the enclosure/cabinet and the wall, using stainless steel hardware.

C. Where mounting directly on the wall is unavoidable the back of the enclosure shall be painted with two coats, minimum, of a bituminous paint.

D. Cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures/cabinets or gutters. Minimum bending radii as recommended by cable manufacturers shall not be reduced.

E. After conduits and cables are installed, the enclosures/cabinets shall be inspected for foreign materials and shall be vacuumed clean. Prior to energization the panels shall be tested as described below.

F. A typewritten directory shall be furnished and installed in the frame inside the panelboard.

3.04 FIELD TESTS

A. Visually inspect each breaker in the panelboard and operate manually.

B. Check all connections for tightness

C. Check current rating of all circuit breakers. To each pole of the circuit breakers apply current 3 times its rating, recording currents and breaker trip times. Apply rapidly increasing currents and record the value that consistently causes instantaneous tripping of the breaker. Compare these recorded times with manufacturer's time current curves.

D. Perform megger and hi-pot test on each pole.

E. All discrepancies found by the contractor shall be brought to the attention of the Engineer

F. All testing shall be performed in the presence of and as directed by the Engineer. The Contractor shall notify the Engineer when the equipment is installed and ready for testing.

END OF SECTION

SECTION 16470

PANELBOARDS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16470A01 Shop Drawings for each enclosure/cabinet shall include:

a. Data sheet for each panelboard with the following information
   1. Job name
   2. Item number
   3. Panelboard nameplate(s) in accordance with the design drawings
   4. Quantity of this panelboard configuration
   5. Phase, wire and voltage
   6. Main and neutral Bus material, continuous current, current density, and momentary capacity.
   7. Short- circuit rating
   8. Main connection information:
      (1) Circuit Breaker - rating, interrupting rating, number of poles, type, manufacturer, and catalog number
      (2) Lugs per phase, Cables per phase, Cable size range
      (3) Location (top, bottom)
   9. Thru feed lugs, subfeed
   10. Ground bar with main lug on frame
   11. Branch connection information:
      (1) Circuit breakers rating, number of poles, type, manufacturer, and catalog number
      (2) Lugs and cables per phase, Cable size range
   12. Panelboard circuits breaker's arrangement for left and right side-top to bottom.
   13. Panelboard overall dimensions H x W x D
   14. Panelboard NEMA rating

b. Panelboard dimensional drawing. Indicate conduit entrance space at the top and bottom, knockout diagram and mounting details

c. Panelboard directory

Catalog Cuts

16470B01 Catalog Cuts

a. Panelboards and Cabinets

b. Circuit breakers

c. Family of time current characteristic curves for all types

Record Documents

16470M01 As-built Documentation acceptable to the Engineer, with typewritten copy of completed panelboard directories.

END OF APPENDIX "A"

DIVISION 16

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for overcurrent protective devices.

B. The types of overcurrent protective devices specified in this Section are:

1. Low Voltage Power Air Circuit Breakers
2. Molded Case Circuit Breakers
3. Safety Switches
4. Fuses

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 37.13	Low Voltage AC Power Circuit Breakers used in enclosures
ANSI C 37.16	Related Requirements and application recommendation for Low Voltage Power Circuit Breakers
ANSI C 37.50	Test Procedures for Low Voltage AC Power Circuit Breakers
ANSI C 97.1	Low Voltage Cartridge Fuses 600 Volts or Less
	National Electrical Manufacturers Association (NEMA)
NEMA AB-1	Molded Case Circuit Breakers and Molded Case Switches
NEMA KS-1	Enclosed Switches
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 98	Enclosed and Dead Front Switches
UL 198	Safety Standard for Fuses
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 943	Standard for Ground Fault Circuit Interrupters

Federal Specifications (FS)

W-C-375B/Gen	Circuit Breakers, Molded Case; Branch Circuit and Service
FSW –S-865	Covers Surface-mounted, Air-break, Box or Enclosed Switches for Ratings through 500 Volts, 1200 Amperes and 50 Horsepower

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The overcurrent protective devices and associated materials shall conform to all applicable standards, and shall also conform to the requirements specified herein and shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

Overcurrent protective devices of types and ratings required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Overcurrent protective devices to be installed in an assembly, as shown on the Contract Drawings, shall be mounted in the assembly and delivered in accordance with the manufacturer's specifications for such assembly.

B. Overcurrent protective devices to be installed in their own enclosures, as shown on the Contract Drawings, shall conform to the following requirements:

1. Enclosures shall be packaged with material to prevent damage to components due to vibration, jarring and the like during transportation and handling.

2. Enclosures shall be delivered in the manufacturer's original, unopened, protective packaging and shall be identified with suitable non-corrosive tags.

C. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of the final cleanup.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPARE PARTS

Furnish a minimum of three but not less than 10% spare fuses of each type and rating required and shown on the Contract Drawings.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide low voltage power circuit breakers, molded case circuit breakers, safety switches and fuses of one of the manufacturers specified on the Contract Drawings.

2.02 MATERIALS

A. General

1. Location, types, sizes, ratings and enclosures for overcurrent protective devices are shown on the Contract Drawings.

2. Overcurrent protective devices mounted in their own enclosures as shown on the Contract Drawings shall conform to the requirements of NEMA, UL, and NFPA. Enclosures shall be as specified in the Section of these Specifications entitled "PANELBOARDS ".

3. Overcurrent protective devices, to be installed as part of an assembly unit, shall be installed in accordance with the manufacturer's requirements for the specified assembly or as shown on the Contract Drawings.

4. Overcurrent protective devices and enclosures for which there are established UL standards, shall bear the UL label.

B. Low Voltage Power Air Circuit Breakers

1. General

a. All circuit breakers shall be 3 pole, single throw, 600V AC class, 60 Hz, trip free, with stored energy closing. Controls shall be as shown on the Contract Drawings.

b. Circuit breakers shall be of the draw-out type with self-aligning fingers to engage the line and load primary terminals.

c. The draw-out mechanism shall firmly support the breaker from the fully connected to the fully disconnected positions and shall be so designed as to permit racking the breaker without opening the door in all three positions: connected, test, and disconnected.

d. Interlocks shall be provided to prevent racking the breaker from the connected position to the test or disconnected position, or moving the breaker into the connected position while the breaker is closed.

e. Required circuit breaker sizes and ratings shall be as shown on the Contract Drawings.

f. In addition to all contract requirements to achieve the operation indicated on the Contract Drawings and specifications, provide the following spare contacts rated 125 VDC, 20 amperes continuous.

(1) A minimum of two normally open and two normally closed contacts, which shall operate when the breaker is in the fully connected position.

(2) A minimum of one normally open and one normally closed contacts, which shall operate when the breaker is withdrawn from the fully connected position. Contacts shall be rated 125V DC, 20 amperes continuous.

g. Provide a position indicator visible from the front of the switchgear for each breaker to indicate whether the breaker is open, tripped or closed.

h. Tripping shall be through integrally mounted solid state overcurrent and short circuit trip units with adjustable settings for long time, short time and instantaneous trip unless otherwise shown on the Contract Drawings.

2. Manually Operated Breakers

a. Provide manually operated circuit breakers with a front mounted handle to manually charge the stored energy closing mechanism.

b. Breakers shall be mechanically trip free and shall be furnished with provisions for the future addition of a control solenoid for remote closing.

c. Provide a mechanical trip and close button on the front of each breaker.

d. Provide a maintenance handle for slow closing during contact adjustment.

3. Electrically Operated Breakers

a. Provide electrically operated breakers with a motor- operated, stored-energy, closing mechanism. Motor voltage shall be as shown on the Contract Drawings.

b. Breakers shall be electrically and mechanically trip-free and each shall be provided with an electrically operated spring release to close the breaker.

c. Provide a mechanical trip button on the front of each breaker.

d. Provided an electrical close button or control switch on the front of each breaker.

e. Provide a maintenance handle for slow closing during contact adjustment.

f. Provide breakers with a shunt trip device for remote operation, arranged for both local and remote control of the closing and tripping functions.

4. Fused Circuit Breakers

a. Where shown on the Contract Drawings, fused circuit breakers shall be provided.

b. The fuses shall be current limiting type and shall be integrally or separately mounted units coordinated with overcurrent trip devices so as to avoid unnecessary blowing of the fuses.

c. Fused breakers shall have a blown fuse indicator and lockout device. The lockout device shall trip all phases upon blowing and prevent the breaker from being closed with any fuse element blown. Operation of the breaker shall not be permitted by this device until the fuse is replaced and the lockout reset.

d. The blown fuse indicator shall be visible from the front of the breaker and shall indicate which fuse has blown.

e. When a Protective Device Coordination Study is performed, the fuse rating shall be in accordance with the requirements of the protective study.

C. Molded Case Circuit Breakers

1. General

a. Molded case circuit breakers for panel or individual mounting shall be molded-case type, quick-make and quick-break on manual or automatic operation. The handle mechanism shall be trip-free to prevent holding contacts closed on a fault. Tripping shall be indicated by the handle automatically assuming a position between the manual "off" and "on" positions.

b. Molded case circuit breaker contacts shall be of the high-pressure type and shall be made of a silver composition material. Arc shields shall be provided to confine, cool, and quench the arc drawn at interruption.

c. Continuous ampere ratings and number of poles shall be as shown on the Contract Drawings.

d. Molded case circuit breakers shall be bolt-on type. Unless otherwise shown on the Contract Drawings or as required by the system interrupting rating, all 120V or 208V circuit breakers shall have a minimum short circuit interrupting rating of not less than 10,000 amperes (RMS symmetrical) and all 277V or 480V breakers shall have a minimum short circuit interrupting rating of not less than 18,000 amperes (RMS symmetrical).

e. All molded case circuit breakers feeding 120V or 277V lighting circuits that are not controlled by local wall switches shall be UL approved type "SWD" circuit breakers.

f. Each molded case circuit breaker shall be suitable for the circuit on which it is applied and the load that it controls.

g. Accessories including, but not limited to, auxiliary switches, shunt trips, undervoltage trips, ground fault sensing and tripping shall be as shown on the Contract Drawings.

2. Thermal-Magnetic Circuit Breakers

a. Circuit breakers up to, but not including 400 amperes shall be thermal magnetic trip. Electronic trip circuit breakers rated 100 amperes or higher may be provided in lieu of thermal magnetic type.

b. Automatic operation of the molded case circuit breaker shall be obtained by means of calibrated thermal and magnetic tripping devices for each pole of the breaker. The thermal device shall provide time-delay tripping on overloads, and the magnetic device shall provide instantaneous tripping on short circuits. The instantaneous magnetic trip shall be adjustable and accessible from the front of the breaker on frame sizes above 100 amperes.

3. Electronic Trip Circuit Breakers

a. Circuit breakers rated 400 amperes and higher shall be electronic trip.

b. The integral trip system shall be independent of any external power source and shall contain industrial grade electronic components as a minimum.

c. Circuit breakers shall be equipped with back-up thermal magnetic trip system unless otherwise indicated on the Contract Drawings.

d. Circuit breaker trip system shall be a microprocessor based true rms sensing design.

e. The sensor size rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker.

f. The following time/current adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.

Long time pick up
Long time delay
Short time pick up
Short time delay
Instantaneous pick up
Ground fault pick up
Ground fault delay

g. A means to seal the trip unit adjustments in accordance with NEC shall be provided.

h. Local visual trip indication for overload short circuit and ground fault trip occurrences shall be provided.

D. Safety Switches

1. Safety switches shall conform to NEMA KS-1, UL 98 and FSW-S-865.

2. Safety switches shall conform to the NEMA classification and shall be rated, as shown on the Contract Drawings.

3. Safety switches utilized for service entrance shall include a groundable insulated neutral.

4. Safety switches shall be of the quick-make, quick-break type with terminals suitable for copper conductors, shall be padlockable in the "off" position and shall be equipped with defeatable door interlocks.

E. Fuses

1. Fuses shall be of the class, size and ratings (current, voltage, interrupting capacity, type, NEMA class) as shown on the Contract Drawings.

2. Fuses shall conform to UL 198 and ANSI C97.1 for low voltage fuses.

3. Unless otherwise shown on the Contract Drawings, fuses used in conjunction with motor protection shall be current limiting, dual element, time-delay type.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Unless otherwise shown on the Contract Drawings, overcurrent protective devices shall be installed in conformance with NFPA 70, and UL 98, in accordance with the manufacturer's instructions and in accordance with the requirements of this Section.

B. Fuses

1. All fuses rendered inoperative during the Work shall be replaced before the issuance of the Certificate of Final Completion.

2. All replacement fuses shall be provided in addition to the spare fuses specified in 1.07 herein.

END OF SECTION

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16475A01 Fuses; time-current and current-limiting curves for both melting and clearing.

16475A02 Circuit breakers; time-current curves.

16475A03 Fused circuit breakers - time current curves.

Catalog Cuts

16475B01 Low Voltage Power Air Circuit Breakers.

16475B02 Molded case circuit breakers.

16475B03 Safety Switches

16475B04 Fuses

END OF APPENDIX "A"

DIVISION 16

SECTION 16477

PROTECTIVE DEVICE COORDINATION STUDY

PART 1. GENERAL

1.01 REFERENCES

The following is a listing of publications referenced in this Section.

	American National Standards Institute (ANSI)
ANSI C 37.91	Protective Relay Applications of Power Transformers
	Institute of Electrical and Electronics Engineers Inc. (IEEE)
IEEE 242	Protection and Coordination of Industrial and Commercial Power Systems
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code

1.02 QUALITY ASSURANCE

A. The PDCS shall be certified by a Professional Engineer licensed in the State where the installation will take place. The qualifications of the Professional Engineer shall be submitted for review and approval by the Engineer.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.03 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 COORDINATION STUDY

Unless otherwise shown on the Contract Drawings, the PDCS shall start from the designated connection point and shall include all protective devices and circuit elements shown on the Contract Drawings. In general, such devices and elements shall include, but not be limited to conductors, high voltage fuses or circuit breakers, transformers, low voltage switch-gear, fuses, circuit breakers, panel boards, motor control centers, transfer switches, and all or switching devices within the distribution system. This requirement shall apply to both AC and DC systems. The PDCS shall conform to the requirements of ANSI C37.91, IEEE 242, NFPA 70, and this Section.

A. Short Circuit Analysis

The Short Circuit Study will be considered a part of the PDCS. The Short Circuit Study shall be performed by using a computer software DAPPER or A_FAULT by SKM Systems Analysis. Results of such a study shall be provided on hard copy as well as on a floppy disk.

1. The short circuit analysis shall study the distribution protective and switching devices and conductors, for both continuous and fault current capabilities. This shall include the ability of the devices and conductors to withstand fault current until the protective devices operate.
2. The short -circuit analysis shall analyze the electrical system, to identify the maximum short circuit values available at each protective device and on the conductors within the system.
3. The short circuit analysis shall be based on the characteristics of the equipment, conductors, raceways and routings actually used in the construction.
4. The short circuit analysis shall be based on the actual available short circuit from the utility at the designated connection point.

B. Protective Device Coordination Analysis

The Protective Device Coordination Analysis shall be performed by using the latest version of the computer software called CAPTOR by SKM Systems Analysis. Results of such a study shall be provided on hard copy as well as on a floppy disk.

1. The analysis shall clearly define the proposed coordination among the devices which include, circuit breakers, overcurrent relays, fuses, transformers, motor sand cable damage curves, magnetizing inrush currents, fault currents and currents related to each device's proposed ratings and settings.
2. The analysis shall establish the settings necessary to selectively isolate faults or failures from the remainder of the electrical system with minimum power interruption.

C. Coordination Plots

The coordination plots shall graphically demonstrate the proposed coordination for the electrical system, plotted on ANSI standard, full-sized, log-log forms such as Time-Current Characteristic forms by Keuffel & Esser Co. The coordination plots shall be plotted on a plotter. No hand drawn plots shall be accepted.

1. The plots shall define the types of protective devices selected, together with the CT ratio selected, proposed taps, time-dial and instantaneous settings.

2. All the coordination plots shall be submitted on hard copies as described above, as well as on computer floppy disks suitable for the approved protective device coordination software as defined section "B" above. In addition, the individual Time-Current Characteristic curves of all the protective devices used in the study shall be provided on a computer floppy disk in the proper format as well as original manufacturer's curves for future reference by the Authority.

3. The coordination plots shall include complete titles, representative one-line diagrams, associated system characteristics, complete parameters for transformers and complete operating bands for distribution circuit breaker trip devices and fuses.

   a. The long-time region of the plots shall designate the pickups required for the circuit breakers.

   b. The short -time region shall indicate the magnetizing inrush, and ANSI transformer withstand parameters, the circuit breaker ground -fault, short -time and instantaneous trip settings, fuse minimum melting and total clearing time, tolerance bands and symmetrical fault currents.

   c. Molded case circuit breakers shall be separated from each other and the associated upstream and downstream protective devices by a current or time margin for coordination and protection in the event of secondary faults.

   d. The protective device characteristics or operating bands shall be suitably terminated to reflect the actual symmetrical fault currents sensed by the device.

   e. Each primary protective device required for delta-to-wye connected transformers shall be selected so that the characteristics or operating bands are within the transformer parameters, which shall include a parameter equivalent to 58 percent of the withstand point to afford protection for secondary line -to-ground faults. The transformer damage curve shall be included for the transformer when the selected protective device is not within the associated parameters.

   f. The coordination plots shall include the damage curves for the transformers, cables and rectifiers. Actual curves provided by the manufacturers of the respective equipment shall be where ever possible.

4. The Authority will furnish settings and fault impedances up to the first level of the upstream protective devices owned by the Authority.

5. The PDCS shall take into account the general characteristics and requirements for the wires, cables, motors, transformers, circuit breakers, rectifiers and any other high and low voltage equipment.

6. All specific equipment characteristics shall be determined in accordance with the results of the PDCS. Report to the Engineer any conditions within the Work, or within equipment not installed under this Contract, where the study recommendations, as approved by the Engineer, require equipment types or sizes other than the requirements of the Specifications, or as shown on the Contract Drawings. The Contractor's compensation for completing such changes, at the direction of the Engineer, will be determined in accordance with the clause of the Contract providing compensation for Extra Work.

7. The study shall include verification of equipment ratings and settings. The results of the study shall be coordinated with the shop drawings required by various other Sections of the Specifications. The Contractor shall maintain the PDCS up-to-date with any Contract changes that affect the study recommendations, and shall submit the revised PDCS for approval by the Engineer.

END OF SECTION

SECTION 16477

PROTECTIVE DEVICE COORDINATION STUDY

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Qualifications

16477K01 Submit in advance, to the Engineer, for approval, the qualifications of the Professional Engineer specified in 1.02 A.

Record Documents

16477M01 Submit six bound copies of an initial protective device coordination analysis and short circuit study. Submit revised copies of the study in accordance with the requirements of 2.01.

END OF APPENDIX "A"

DIVISION 16

SECTION 16510

LIGHTING SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for Lighting Systems.

1.02 REFERENCES

	American National Standards Institute (ANSI)
ANSI C 78.379	Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns
ANSI C 82.1	Ballasts for Fluorescent Lamps – Specifications
ANSI C 82.4	Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps
	Illuminating Engineering Society of North America (IESNA)
	National Equipment Manufacturers Association (NEMA)
NEMA WD6	Wiring Devices - Dimensional Requirements
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
NFPA 101	Life Safety Code
	Administrative Code
NYCEC	Electrical Code of the City of New York
	Underwriters Laboratories (UL)
UL 57	Electric Lighting Fixtures
UL 844	Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	Emergency Lighting and Power Equipment
UL 935	Fluorescent Lamp Ballasts
UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1570	Fluorescent Lighting Fixtures
UL 1571	Incandescent Lighting Fixtures
UL 1572	High Intensity Discharge Lighting Fixtures

OSHA Occupation Safety and Health Administration

The Energy Policy Act of 1992

Lamp Efficiency Labeling and Standards

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Lighting System shall be furnished, supplied, installed and adjusted in accordance with this Section and as specified on the Contract Documents.

B. Components of the Lighting System manufactured, supplied, and installed shall comply with the requirements of NFPA 70, NFPA 101, all local codes, and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. Entities manufacturing lighting fixtures, equipment, and components specified herein, and as shown on the Contract Drawings, shall have a minimum of five years of manufacturing experience and shall demonstrate prior experience on at least two projects involving complexities similar to those required under this Contract.

B. Lighting equipment for which there is a nationally recognized standard shall be safety tested and bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc. (UL), ETL, Factory Mutual, or approved equal, certifying that the lighting fixtures and equipment are listed as suitable for the purpose specified and shown on the Contract Drawings.

C. Lighting equipment shall be manufactured and installed in compliance with applicable articles of NFPA 70, NFPA 101 and NYCEC.

1.05 DELIVERY, STORAGE AND HANDLING

A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.

B. Deliver materials in manufacturer's original, unopened, protective packaging.

C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.

D. Handle in a manner to prevent damage to finished surfaces.

E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

1.06 SPARE PARTS

A. Unless otherwise noted on the Contract Document, provide 10% (or minimum of 12) replacement lamps for each type of lamp installed.

B. Unless otherwise noted on the Contract Document, provide 5% (or minimum of 2) replacement ballasts for each type of ballast installed.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. General

All components of the lighting system shall be manufactured by the companies shown on the Contract Drawings.

2.02 MATERIALS

A. General

The location, number, size, and type of all lighting fixtures and accessories to be installed shall be as shown on the Contract Drawings.

B. Lighting Fixtures

Lighting fixtures shall be furnished with lamps, which comply with the requirements of this Section, and as shown on the Contract Drawings. All fluorescent and high intensity discharge lighting fixtures supplied shall come with factory installed ballasts, which comply with the requirements of this Section, and as specified on the Contract Drawings.

Unless otherwise shown on the Contract Drawings lighting fixtures shall comply with the following requirements:

1. Housing

a. Lighting fixtures shall be of rigid construction and built in accordance with NEMA WD6.

b. Ferrous components shall be protected from corrosion by plating or finished with white baked enamel unless another color is shown on the Contract Drawings. All paint shall be spray-applied and baked at 350°F, for at least 20 minutes. Interior surfaces of all fluorescent fixtures shall be white enamel of minimum 87% reflectance.

c. Exposed parts of the lighting fixture housing shall be free from spinning lines, ripples, or other visible marks and manufacturer's stickers.

d. Outdoor lighting fixture housings shall be constructed of copper-free cast aluminum (copper content less than 0.4%, Alloy 360.4) or stainless steel. Housings shall be properly gasketed to be watertight. All hardware shall be stainless steel.

e. Recessed lighting fixture housings shall be constructed of a minimum 20-gauge cold-rolled steel and painted with a white, baked enamel finish.

f. Pendant and surface-mounted, continuous lighting fixture housings shall be constructed of extruded aluminum and treated with the finish specified on the Contract Drawings.

g. Ballast compartment shall be so designed that ballast temperature shall not exceed the UL limit of 105°C at 40°C ambient temperature.

2. Optical System

a. Reflectors

(1) Unless otherwise shown on the Contract Drawings, fluorescent, parabolic louvers shall be constructed of non-iridescent, semi-specular aluminum with a minimum reflectance of 85%.

(2) Diffuser reflectors shall be finished with high-reflectance, baked white enamel with a non-yellowing binder.

(3) Clear reflector inserts for fluorescent lighting fixtures shall be fabricated of aluminum or steel backing with a silver film laminate which shall be guaranteed by the entity manufacturing the lighting fixtures against separation and peeling for a minimum of five years. Minimum reflectance shall be 92%.

(4) The visible clear Alzak reflectors shall be of non-iridescent finish with a minimum reflectance of 90%.

b. Lenses, Diffusers, and Shielding Devices

(1) Lenses, diffusers, and shielding devices shall be properly and securely mounted within the lighting fixture housing. Lay-in lenses, diffusers, or shielding devices shall not be acceptable.

(2) Glass lenses or diffusers shall be constructed of tempered, borosilicate glass.

(3) Plastic lenses or diffusers shall be white opal or clear, prismatic, 100% ultraviolet-stabilized acrylic or high-impact polycarbonate. Plastic lenses shall be installed with the smooth side out.

(4) The shielding and optical materials shall be tightly fitted with no loose parts and shall show no visible leaks of unintentional light.

3. Exit Signs

a. Furnish single and double face Exit Signs with hardware suitable for wall or ceiling mounting as shown on the Contract Drawings.

b. Exit Signs shall be guaranteed by the manufacturer for a minimum of five years.

c. Surface mounted Exit Signs shall be of die-cast aluminum construction with aluminum faceplates and invisible universal arrows and mounting knockouts for field adjustment. Finish of the housing and faceplates shall be as shown on the Contract Drawings. Exit Signs shall be single or double face, and shall be suitable for ceiling, back, or end mounting.

d. Edge-lit Exit Signs shall be of UV stabilized acrylic construction with inbeded, laminated legend and arrows.

e. Exit Signs shall be energized from either 120 VAC or 277 VAC. Exit Signs shall operate on Light Emitting Diode (LED) light sources and shall consume a maximum of six watts per Sign face.

f. Average luminance of the legend "EXIT" shall be no less than 15 cd/m^2 (5 Fl) with uniformity ratio (max/min) no greater than 3/1.

4. Emergency Battery Operated Lights

a. Emergency Battery Operated Lights specified herein shall be:

(1) Fluorescent Fixture with internal or external battery pack

(2) Battery Operated Exit Sign

(3) Incandescent Emergency Lighting Fixture

b. Emergency Battery Operated Lights shall automatically switch "ON" when normal or emergency power supply fails and provide a minimum of 90 minutes of reduced illumination.

c. The fluorescent batteries of fixtures used for both, normal and emergency lighting, shall be of the nickel-cadmium or the lead-calcium type and shall have sufficient electrical capacity to energize the connected lamps at a minimum of 50% of normal light output. The battery shall be guaranteed by the manufacturer for a minimum of five years.

d. The battery charger shall be the dual-rated type and shall have sufficient capacity to recharge the discharged battery to full charge within twelve hours, maximum.

e. Emergency Battery Operated Lights shall be equipped with a test switch and an LED lamp indicating AC power is on.

C. Lamps

1. General

Lamps shall comply with the requirements of the Energy Policy Act of 1992 or it's latest editions.

2. Fluorescent Lamps

Unless otherwise shown on the Contract Document, lamps shall comply with the following requirements:

a. Tubular Type

(1) Lamp tube diameter shall be T8, T10, or T12

(2) Lamps shall have triphosphor coating with a minimum Color Rendering Index (CRI) of 70

(3) Minimum average lamp life at 3 hours per start shall be 20,000 hours

(4) Minimum efficiency shall be 80 lm/W (lumens per Watt).

(5) Maximum lamp lumen depreciation at the end of rated life shall be 20%

b. High Output (HO) and Slimline Type

(1) Lamp tube diameter shall be T8 or T12

(2) Lamps shall have triphosphor coating with a minimum Color Rendering Index (CRI) of 70

(3) Minimum average lamp life at 3 hours per start shall be 12,000 hours

(4) Maximum lamp lumen depreciation at the end of rated life shall be 20%

c. Compact Fluorescent Lamps

(1) Minimum average lamp life at 3 hours per start shall be 10,000 hours

(2) Lamp shall have a triphosphor coating with a minimum Color Rendering Index (CRI) of 82

(3) Minimum efficiency shall be 65 lm/W

(4) Maximum lamp lumen depreciation at the end of rated life shall be 15%

3. Incandescent and Tungsten Halogen Lamps

Unless otherwise shown on the Contract Document, lamps shall comply with the following requirements:

a. Incandescent and tungsten halogen lamps shall have a minimum average lamp life of 2500 hours.

b. Incandescent reflector type lamps shall have beam patterns as shown on the Contract Drawings and conforming to ANSI C 78.379.

4. High Intensity Discharge Lamps

Unless otherwise shown on the Contract Documents, lamps shall comply with the following requirements:

a. High Pressure Sodium (HPS) Lamps

(1) Minimum average lamp life at 10 hours per start: 24,000 hours

(2) Minimum efficiency: 75 lm/W

(3) Maximum lamp lumen depreciation at the end of rated life: 20%

(4) Maximum color shift: ±250 degrees Kelvin

b. Metal Halide (MH) Lamps

(1) MH lamp fixtures shall be connected only to circuits that are turned off for at least 15 minutes a week. Use of MH lamps in uninterrupted 24-hour operation circuits is not permitted.

(2) Minimum average lamp life at 10 hours per start shall be 15,000 hours for lamp burning in a vertical position. For lamps burning in a horizontal position, as follows:

Lamps < 400 W:	10,000 hours
400 W lamps:	20,000 hours
1000 W lamps:	12,000 hours
1500 W lamps:	6,000 hours

(3) Minimum efficiency: 75 lm/W

(4) Maximum lamp lumen depreciation at the end of rated life: 30%

(5) Maximum color shift: ±250 degrees Kelvin.

(6) Minimum Color Rendering Index (CRI): 65

c. Mercury Vapor (MV) Lamps

Unless otherwise shown on the Contract Drawings, MV lamps shall not be permitted for general illumination purposes.

D. Ballasts

1. Fluorescent Lamp Ballasts

a. Fluorescent lamp ballasts shall comply with ANSI C 82.1 and shall be Class 'A' sound rated Class 'P' listed by ETL and UL.

b. Fluorescent lamp ballasts shall be certified for the appropriate for the application minimum starting temperature.

c. Unless otherwise shown on the Contract Drawings, fluorescent lamp ballasts for indoor applications shall be high-frequency, electronic type, suitable for *operation in rapid start circuitry and comply with the following requirements:*

(1) Minimum Power Factor: 0.950

(2) Total Harmonic Distortion: less than 20%

(3) Lamp Current Crest Factor: less than 1.7

(4) Lamp Current Frequency: greater than 20 kHz

(5) In-rush current: less than 20x normal current

d. Fluorescent lamp ballasts shall be wired and grounded in accordance with NFPA 70 and the manufacturer's written instructions.

2. High Intensity Discharge (HID) Ballasts

a. HID lamp ballasts shall comply with ANSI C 82.4, and shall be the high-power factor, constant wattage auto-transformer (CWA), or similar, type of automatic wattage regulation.

b. The power loss of HID lamp ballasts, as a percentage of lamp wattage, shall not exceed 20%.

c. HID lamp ballasts for indoor applications in public spaces shall be encased and potted for the purpose of noise reduction.

d. HID lamp ballasts shall be wired and grounded in accordance with NFPA 70 and the manufacturer's written instructions.

e. Remote HID lamp ballasts shall be installed in accordance the manufacturer's written instructions.

f. Unless otherwise noted on the Contract Drawings all HPS ballasts, which are not used in 24 hours operations, shall be furnished with automatic protective starters. An automatic protective starter shall apply pulses for no more than 15 minutes and then deactivate if a lamp arc cannot be initiated.

E. Fuses

Fuses and fuse assemblies shall be as shown on the Contract Drawings.

F. Lighting Control

1. Lighting Management System

a. The lighting management system shall automatically switch lights on and off according to a time clock schedule, amount of daylight present, and in accordance with the requirements of this section and as shown on the Contract Documents.

b. A factory-trained field service engineer shall be to functionally test each hardware and software component in lighting management system after installation, and to provide on-site training for Authority personnel. The minimum of 16 hours training session shall consist of the following parts:

(1) general description of the system and operational functions of it's components

(2) hands on training for each of the hardware components (performance, maintenance, repair, parts replacement)

(3) hands on software training (programming, operation, modem connection)

At least two representatives from the facility where the system is being installed, two representatives from the electrical maintenance group and two representatives from the Authority engineering department shall be present for the training.

Manufacturer shall provide a minimum of 6 complete operation manuals.

c. Remote Power Switching Panelboards

(1) The remote power switching lighting panelboards shall be mounted in electrical closets and shall comply with Section 16470 of these Specifications and as specified on the Contract Documents.

(2) The remote power switching panelboards shall consist of a microprocessor-based control module, interface module, control busses, remote-controlled breakers, and Class 2 barriers.

(3) The remote power switching panelboards shall meet or exceed the following capabilities:

(a.) Individual control for up to 42 remotely controllable circuit breakers.

(b.) Eight dry-contact inputs for connection to either 2-wire maintained or 3-wire momentary external control devices.

(c.) Zone creation and control of individual circuit breakers or zones.

(d.) Run/Halt/Hold/All-On operational modes.

(e.) Individual circuit breaker and zone manual override.

(f.) Circuit breaker status monitoring.

(g.) Security access codes.

(h.) Telephone override.

(i.) Diagnostic testing of memory, keyboard, screen, com ports, and circuit breaker.

(j.) Expansion port to connect additional inputs via expansion cabinet.

(k.) RS-232 port for connection to personal computer.

(l.) Non-violable EEPROM memory.

(4) All electronic modules and circuit breakers in the panelboards shall be mounted in the positions and control the loads as indicated on the panel wiring schedules indicated on the Contract Drawings.

(5) Emergency panelboards shall respond to the loss of normal power in the associated normal panel by automatically switching on all emergency circuits.

d. Addressable Relay Panels

(1) Addressable relays shall provide inputs and outputs directly compatible with the existing remote power switching panelboard system.

(2) Each remotely controlled relay panel shall be furnished with at least one manual on/off override.

(3) The addressable relay panels shall meet or exceed the following capabilities:

(a.) Protocol shall be based on a modified ANSI 3.28.

(b.) Run length without repeaters shall be 10,000 feet at 9,600 Baud, full duplex.

(c.) Up to 16 analog inputs and digital inputs. These inputs shall except directly, occupancy sensors and variable output ambient light sensors.

(d.) All information shall be stored internally in register locations and be readable/writeable from any device on the high-speed network.

(e.) Addressable in the range of up to 32 panels.

2. Photoelectric Control Devices

a. The location, number, size, and type of all ambient light sensors, timers, and occupancy sensors to be installed shall be as shown on the Contract Drawings.

b. The ambient light sensor shall have a cadmium sulphide, hermetically sealed photocell, shall be fully temperature-compensated, and shall provide for a time delay of at least 15 seconds to prevent false switching. The ambient light sensors shall be remotely mounted where shown on the Contract Drawings.

c. The ambient light sensor shall meet or exceed the following capabilities:

(1) There shall be different lighting sensors for different tasks (i.e. atrium, skylight and outdoor).

(2) Separately mounted resolution enhancement adjustment.

(3) The photoelectric device shall be a class 2, low voltage type.

(4) Output shall be directly proportional to light measured.

(5) Fully adjustable response in the range between 0 and 10,000 foot-candles with +/-1% accuracy at 21C.

(6) The housing shall be constructed from flame-retardant material, and meet UL984 HB standards.

(7) Outputs shall be 4-20mA or 0-10Volt.

(8) Power supplies shall be available in a range of voltages.

d. The time switch shall function to prevent lighting from being energized at pre-set periods each day. The time switch shall permit different "ON-OFF" settings for each day of the week, with provision for omitting selected days. The time switch shall have at least 4 inputs. Unit shall be capable of retaining memory for no less than 90 days. When permitted by the time switch, photoelectric controls shall operate to energize lighting whenever natural lighting falls below 2,5 lux (25 FC).

3. Occupancy sensors

a. The occupancy (motion) sensors shall be designed to control lighting automatically based on the presence or absence of people.

b. The ultrasonic occupancy sensors shall produce a low intensity, inaudible sound (above 22KHz) and detect changes in the acoustic waves caused by motion. The sensors shall not respond to audible sound. If the sensors detect motion, the internal or external relays shall close the contacts and turn on the connected lighting loads. If no motion occurs within a pre-set period of time, the lights shall be automatically turned off.

c. Ultrasonic detectors shall be precision crystal-controlled. Sensors shall not interfere with each other when two or more sensors are placed in the same room.

d. The passive infrared occupancy sensors shall maintain a detection when the person of average size and weight moves within a maximum distance of 8 inches at the speed of 12 inches per second.

e. The occupancy sensors shall be equipped with LED walk indicator, which shall be visible from any area in the room.

f. The occupancy sensors shall be furnished with an adjustable timer for delayed turn-off. The time delay shall be adjustable from 30 seconds to 15 minutes.

g. The occupancy sensors shall be furnished with adjustable sensitivity control. Although, sensitivity shall be high, false triggering by random noises or motions other than human movement shall not be permitted.

h. The occupancy sensors shall be furnished with manual override switch that will enable a bypass of the sensor in the event of failure.

i. The sensors shall be connected to power modules. The power module consumption shall not exceed 2VA in any mode of operation. The power modules shall combine a Class 2 (120V/277V) transformer and heavy duty relay with form A isolated contacts in a single housing. The relay shall be rated for 20A operation.

j. The sensors shall be suitable for ceiling-mounted installation and shall not protrude more than 1-1/2 inches from the ceiling surface.

k. All sensors or equipment supplied shall be accompanied by electronic circuit diagram; component layout, circuit description and installation instructions.

l. All devices shall have a minimum three-year factory warranty for materials and labor.

m. All sensors shall be properly masked and adjusted for required sensitivity and time delay. Coordinate adjustments with manufacturer.

4. Dimmers

a. Wallbox dimmers shall be of linear sliding type and shall be rated for operation with the specified connected load. Dimmer shall be designed to smoothly change light output of the lamps without visible flicker. Rotary type dimmers are not permitted.

b. Wallbox dimmers shall be equipped with built in on/off switch and preset control button.

c. Furnish an appropriate wallbox dimmer for each individual type of load:

(1) Incandescent

(2) Electronic low voltage

(3) Magnetic low voltage

(4) Fluorescent

d. Preset dimming control system shall be as shown on Contract Drawings and shall meet or exceed the following capabilities:

(1) System shall have four preset scenes and off for up to 8 control zones.

(2) System shall be mountable in a standard 2, 3 or 4 gang metal wallbox. Wallbox shall be as specified in Section 16135 of this Specification.

(3) One raise/lower switch with visual display shall be available for each zone.

(4) A temporary master raise/lower switch shall move all light levels up or down.

(5) System shall have smooth fade mode. Switching time between scenes shall be adjustable from 1 second to 90 minutes.

(6) A temporary zone override shall be provided.

(7) Multiple controls and remote wallstations shall be capable of activating each of the preset scenes and shall not interfere with each other.

G. Contactors

1. Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contactors shall be required to make, but not break, the operating coil current.

2. The contactor's main contacts shall be the double break, silver-to-silver type protected by arcing contacts. Contacts shall be self-aligning and renewable from the front of the panel.

3. The contactor's control connections shall be clearly marked "L" for line wire, "C" for closing wire, and "O" for opening wire. A manual operating lever shall be included with the contactor.

4. Each contactor shall be equipped with a control line fuse, a coverplate to conceal contacts, and one normally open auxiliary contact.

5. Unless otherwise shown on the Contract Drawings, contactors shall be mounted separately in a sheet steel, NEMA 12 enclosure. Grouped contactors shall be installed in a common sheet steel, NEMA 12 enclosure.

6. Unless otherwise shown on the Contract Drawings, relays for two-wire control shall be provided, where required, for the operation specified on the Contract Drawings.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all lighting fixtures, equipment, and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing lighting fixtures.

B. Unless otherwise shown on the Contract Drawings, all lighting outlets shall have lighting fixtures. In instances where a specific lighting fixture has not been assigned to a lighting outlet, furnish and install a complete lighting fixture of the type and wattage designated for outlets of similar function and/or type as directed by the Engineer.

C. Unless otherwise shown on the Contract Drawings, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture. The design of hangers and the method of fastening other than what is shown on the Contract Drawings, or herein specified, shall be submitted to the Engineer for approval.

3.03 INSTALLATION

A. Install all lighting equipment and accessories, as well as all lighting fixtures, complete with lamps, in the locations shown on the Contract Drawings in accordance with the manufacturer's written instructions. All lighting fixtures shall be properly secured to structural elements.

B. Lighting fixtures shall be carefully supported and aligned with necessary hangers, supporting members, and plaster frames for proper installation, all as shown in the Contract Drawings and the Specifications, and as approved by the Engineer. No rivets, springs, or other hardware shall be visible after installation.

C. Lighting fixtures shall be supported to satisfy seismic requirements described in applicable local codes.

D. All lighting fixtures shall be properly wired and connected to branch circuits, tested, and left ready for operation. Bond all lighting fixtures and metal accessories to the branch circuit-grounding conductor.

E. Where a continuous string of lighting fixture is specified to be installed, the lighting equipment shall be installed so as to produce a continuous, straight, unbroken band of light, free of visual imperfections, socket shadows, light gaps, etc.

F. All pendant-mounted lighting fixtures within the same room or area shall be installed plumb, and at a uniform height from the finished floor. Adjustment of a height shall be made during the installation. Unless otherwise shown on the Contract Drawings, stems and canopies shall be matched to the associated lighting fixtures.

G. Install recessed lighting fixtures to permit removal from below. Use accessories and firestopping materials to meet regulatory requirements for fire rating.

3.04 ADJUSTMENTS

A. Prior to final inspection, relamp all fixtures which have failed lamps, or lamps where visible color shift has occurred, and leave all lighting fixtures, equipment, and accessories in good, uniform operating condition. The Contractor shall replace any burned-out lamp during the first 100 days after the completion of the Contract.

B. Aim and adjust all lighting fixtures as shown on the Contract Drawings.

C. Adjust exit sign arrows as shown on the Contract Drawings.

D. Cleaning

1. Clean all components of the lighting system to remove conductive and deleterious materials.
2. Remove dirt and debris from all enclosures.
3. Clean finishes and touch up damage.

END OF SECTION

SECTION 16510

LIGHTING SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16510A01 For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.

16510A02 For each ballast type: Submit manufacturer's data with ballast description, catalog number, lamp type, input voltage, in-rush current, line current, input wattage, ballast factor, power factor, crest factor, minimum starting temperature, total harmonic distortion and wiring diagram.

16510A03 Submit shematic wiring diagrams, component specifications, enclosure dimensions, installation details, operation manual, and approvals of respective standards.

16510A04 Dimmer system components: Submit schematic diagrams, component specifications, enclosure dimensions, installation details, and approvals of respective standards.

16510A05 Photoelectric Control Devices: Submit manufacturer's data for ambient light sensors, timers, infrared and ultrasonic occupance sensors.

Samples

16510C01 If requested on the Contract Drawings, provide mock-up installation for review and approval by the Engineer. The mock-up shall simulate specified lighting system conditions as shown on the Contract Drawings.

16510C02 For each substitution item which is not specified on the Contract Drawings provide mock-up installation at no cost to the Authority if requested, and as directed by the Engineer.

16510C03 For items indicated on the Contract Drawings submit working samples for review and approval upon request by the Engineer. Install and energize samples as shown on the Contract Drawings or as directed by the Engineer.

Certificates

16510E01 For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.

Manufacturer Test Reports

16510F01 For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format.

a. Luminaire, ballast and lamp description and manufacturer's complete catalog number
b. Luminaire drawing with basic dimensions
c. Candela Distribution Table and Curve
d. Coefficient of Utilization Table
e. Visual Comfort Probability Table
f. Zonal Lumen Summary Table
g. Luminance Summary Table
h. Input Watts
i. Luminaire Efficiency

END OF APPENDIX "A"

DIVISION 16

SECTION 16512

COLOR CHANGING LIGHTING SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for Color Changing Lighting System

B. Related Work specified in other Sections of the Specifications includes the following: 16514 LIGHTING SYSTEMS MODIFIED.

1.02 SYSTEM DESCRIPTION

A. The work in this section includes furnishing the following elements and associated accessories to supply a complete and working lighting control system as per the drawings and specifications for the Bayonne Bridge project:

1. Color Changing LED Luminaires
2. Architectural lighting dimming equipment

a. Lighting Control Equipment

(1) The system shall be designed for the control of architectural lighting and shall consist of factory pre-wired control and processing rack enclosures containing electronic controls, relays, power supplies, terminals and control electronics.

(2) System shall work in conjunction with all specified low-voltage control stations.

(3) The system shall provide control signal from a central control processor to substation signal distribution points.

(4) System must be capable of scheduled events and sequences based on a standard calendar and astronomical time clock.

(5) Provide an override control for unscheduled calendar events.

(6) Provide control input for live control and real time snapshots.

b. Architectural Dimming Systems

c. Lighting Networks Interfaces

(1) Substation distribution equipment shall provide control signal to fixture power and data supplies as required to fully and individually control all color-changing architectural fixtures.

(2) The control components shall be capable of utilizing the existing fiber-optic network infrastructure.

(3) Control processor must be accessible from the location of the SCADA control system. Control must be coordinated with SCADA system providers for remote access to lighting system processor.

d. Control Equipment Enclosures.

(1) All control equipment shall be installed in standard wall mounted steel equipment racks with locking doors.

(2) Equipment racks containing network equipment must provide appropriate network cable management and patching equipment as well as uninterruptable power supplies appropriately sized for the associated loads as a standard.

1.03 REFERENCES

The following is a listing of the publications, standard and codes referenced in this Section, of which the latest edition shall govern:

American National Standards Institute (ANSI)

ANSI C 78.377	Chromaticity LED Specification

Illuminating Engineering Society of North America (IESNA)

LM-79	LED Testing and Measurement Guidelines
LM-80	LED Life Measurement Testing Method

National Equipment Manufacturers Association (NEMA)

NEMA WD6	Wiring Devices - Dimensional Requirements

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 101	Life Safety Code

Administrative Code

NYCEC	Electrical Code of the City of New York
NYCECC	New York City Energy Conservation Code
ASHRAE 90.1	Energy Code

Underwriters Laboratories (UL)

UL57	Electric Lighting Fixtures
UL 8750	LED Lighting Fixtures

OSHA Occupation Safety and Health Administration

The Energy Policy Act of 1992

Lamp Efficiency Labeling and Standards

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Lighting System shall be furnished, supplied, installed and adjusted in accordance with this Section and as specified on the Contract Documents

B. Components of the Lighting System manufactured, supplied and installed shall comply with the requirements of NFPA 70, NFPA 101, all local codes and the requirements of OSHA.

1.05 LIGHTING CONTROL SYSTEMS INTEGRATOR

A. General

1. The provider of the system herein described shall be acknowledged in business as a Lighting Control Systems Integration Company, hereafter referred to as LCSI. This company shall employ full time Systems Integrators and Project Managers with experience in completing work of similar or greater size and scope. The role of the LCSI in this project shall be to provide all equipment listed in this section to the Electrical Contractor for installation. The LCSI shall furnish a complete working system to the Electrical Contractor, meeting the intent of this specification. The LCSI shall coordinate delivery schedules and installation of equipment with the Electrical Contractor. Additionally, the LCSI shall be responsible for all documentation for equipment in this section, system record drawings, final testing of the system and training of the Authority's personnel as required by this specification.

B. Description

1. The LCSI shall have experience in the operation and installation of similar equipment associated with the construction and/or renovation of facilities similar in scope to this project.
2. The LCSI shall have been in business for a minimum of 20 consecutive years and shall have no history of bankruptcy.
3. The LCSI shall be an authorized dealer for an adequate number of manufacturers of system products necessary to provide a complete working system meeting the intent of this specification. System products shall include but are not limited to the following:
   a. Dimming Equipment
   b. Control Systems
   c. Power Distribution Equipment
4. The LCSI shall have on staff at least two full-time manufacturer-certified field service technicians and have technical support and assistance accessible 24 hours a day, seven days a week.
5. The LCSI shall offer a Maintenance and Service Contract.
6. The LCSI shall provide a one-year system warranty for the complete system, not including expendable supplies, effective from the date of system acceptance. Within this warranty period, the LCSI shall be responsible as the Authority's sole contact for the remedy, repair, or replacement of system deficiencies (through the manufacturer's warranty where applicable).

C. Project Management

1. The Systems Integration Company shall designate a dedicated Project Manager. The LCSI's Project Manager shall be the main contact between the Systems Integrator, Manufacturers, Lighting Designers, Engineers and Contractors from contract award until final sign off. The LCSI's Project Manager shall be the same person throughout the entire course of the project, unless otherwise approved by the Authority or Engineer.

2. The LCSI's Project Manager shall attend a Kick-Off Meeting at the project site office or a place to be designated. The objectives of the Kick-Off Meeting are:

   a. Introduce the Project Team Members

   b. Review the Project Schedule

   c. Review the Scope of Work and any additional materials and documents not in the Scope of Work

   d. Layout the creative intent of the Project

D. Approved Lighting Control Systems Integration Companies shall be the following, or approved equal:

Barbizon Electric.
456 West 55th Street
New York, NY 10019
Ph: 212-586-1620

Fogel & Associates
2 Lakeside Avenue
Second Floor
Verona, NJ 07044
Ph: 973-571-0300

1.06 QUALITY ASSURANCE

A. Entities manufacturing lighting fixtures, equipment, and components specified herein, and as shown on the Contract Drawings, shall have a minimum of five years of manufacturing experience and shall demonstrate prior experience on at least two projects involving complexities similar to those required under this Contract.

B. Lighting Equipment for which there is a nationally recognized standard shall be safety tested and bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc. (UL, ETL, Factory Mutual or approved equal, certifying that the lighting fixtures and equipment are listed as suitable for the purpose specified and shown on the Contract Drawings.

C. Lighting equipment shall be manufactured and installed in compliance with applicable articles of NFPA 70, NFPA 101 and NYCEC.

D. For Manufacturers

   1. All dimmer and cabinet fabrication must take place in a U.S. manufacturing plant.

   2. Proposed equipment shall be UL and C-UL listed, and/or CE marked (where applicable) and bear the appropriate labels.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, disposed of, and replaced with dry wrapping materials to prevent staining finish

B. Deliver materials in manufacturer's original, unopened, protective packaging.

C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.

D. Handle in a manner to prevent damage to finished surfaces.

E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

1.08 SPARE PARTS

A. Unless otherwise noted on the Contract Document, provide 10% (or minimum of 8) shelf stock for each type of fixture installed.

B. Unless otherwise noted on the Contract Document, provide 5% (or minimum of 2) replacement drivers and data power hubs for each type installed.

1.09 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. General

All components of the color changing lighting system shall be manufactured by the companies shown on the Contract Drawings

B. Acceptable Color Changing Control System Component Manufacturers

Magniflood
7200 New Horizons Blvd. No.
Amityville, NY 11701

Electronic Theatre Controls
3031 Pleasant View Rd
PO Box 620979
Middleton, WI 53562-0979

Pathway Connectivity
#103 - 1439 17th Avenue SE
Calgary AB T2G 1J9
Canada

2.02 MATERIALS

A. General

The location, number, size, and type of all color changing lighting fixtures and accessories to be installed shall be as shown on the Contract Drawings.

B. Lighting Fixtures

Lighting fixtures shall be furnished with RGBW LED arrays, which comply with the requirements of this Section, and as shown on the Contract Drawings. All color changing LED fixtures with integral drivers supplied shall come with factory installed drivers, which comply with the requirements of this Section, and as specified on the Contract Drawings.

Unless otherwise shown on the Contract Drawings lighting fixtures shall comply with the following requirements:

1. Housing

   a. Lighting fixtures shall be of rigid construction and built in accordance with NEMA WD6.

   b. Powder Coated Die Cast Aluminum construction.

   c. Exposed parts of the lighting fixture housing shall be free from spinning lines, ripples, or other visible marks and manufacturer's stickers.

   d. Outdoor lighting fixture housings shall be constructed of copper-free cast aluminum (copper content less than 0.4%, Alloy 360.4) or stainless steel. Housings shall be properly gasketed to be watertight. All hardware shall be stainless steel.

2. Optical System

   a. Lenses, Diffusers, and Shielding Devices

      (1) Lenses, diffusers, and shielding devices shall be properly and securely mounted within the lighting fixture housing.

      (2) Plastic lenses or diffusers shall be translucent white, 100% ultraviolet-stabilized acrylic or high-impact polycarbonate.

      (3) The shielding and optical materials shall be tightly fitted with no loose parts and shall show no visible leaks of unintentional light.

C. LED Arrays

1. LED Arrays

Unless otherwise shown on the Contract Documents, lamps shall comply with the following requirements:

a. Red, Green, Blue, White (RGBW) LED Arrays

(1) RGBW LED Arrays shall be connected to power and data source to utilize the color changing capabilities of the array.

(2) Minimum average lamp life at 25°C shall be 40,000 hours

(3) Maximum wattage: 40W

(4) Minimum efficacy: 50 lm/W

(5) Maximum lamp lumen depreciation at the end of rated life: 30% (L70)

(6) Shall comply with RoHS directive.

(7) Shall comply with IESNA LM-79 and LM-80

D. Control Processor Modules

1. The Architectural Control Processor shall be the Unison Paradigm P-ACP Series Control Processor as manufactured by Electronic Theatre Controls, Inc., or approved equal.

2. Mechanical

a. The Architectural Control Processor (ACP) assembly shall be designed for use in DRd Series Dimming Enclosures and ERn Series Control Enclosures.

b. The processor shall utilize microprocessor based, solid state technology to provide multi-scene lighting and building control.

c. ACP module electronics shall be contained in a plug-in assembly.

(1) The module shall be housed in a formed steel body and contain no discrete wire connections.

(a.) No tools shall be required for module removal or insertion

d. The ACP shall be convection cooled.

e. User Interface

(1) The ACP shall utilize a backlit liquid crystal display capable of graphics and eight lines of text.

(2) The ACP shall provide an alpha-numeric keypad for data entry and navigation.

(3) The ACP shall provide a touch-sensitive control wheel for navigation.

(4) The ACP shall provide shortcut buttons to assist in navigation, selection, and data entry.

(5) The ACP keypad, buttons, and wheel shall be backlit for use in low-light conditions.

(a.) The backlight shall have a user selectable time out, including no time out.

f. The ACP shall provide a front-panel RJ45 jack for Ethernet connection to the processor for configuration, live control, and web-browser-based system access.

(1) The Ethernet port shall be secured behind the locking door.

g. The ACP shall provide a Secure Digital (SD) Removable Media slot on the front panel for transfer of configuration data.

(1) The SD slot shall be secured behind the locking door.

h. *The ACP shall provide a Universal Serial Bus (USB) port on the front panel for* transfer of configuration data.

(1) The USB port shall be secured behind the locking door.

i. Architectural Lighting System configuration and program information shall be stored in flash memory, which does not require battery backup.

(1) The ACP shall provide a Compact Flash (CF) Card as backup flash memory and storage.

(2) The CF Card is stored in the back of the ACP, and can be accessed only by removing the ACP.

(3) The ACP data can be exchanged by inserting the CF card into another ACP

3. Electrical

a. The ACP shall require no discrete wiring connections; all wiring shall be terminated into Dimming or Control Enclosure.

b. The ACP shall require low-voltage power supplied by the Dimming or Control enclosure.

c. The ACP shall be hot-swap capable.

d. The ACP shall support Echelon LinkPower communications with remote devices, including button stations, button/fader stations, Touchscreen stations, sensors, and third party LonMARK compliant products.

(1) The LinkPower network shall utilize polarity-independent, low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded) or equivalent. One # 14 AWG drain wire will be required for system not using grounded metal conduit. Touchscreen stations, interface *stations and portable stations connectors will also require (2) #16* AWG wires.

(2) The LinkPower network shall be topology free. Network wiring may be bus, loop, home run, star or any combination of these.

(3) Link power wiring shall permit a total wire run of 1640 ft. (500m) without a repeater. Repeater option modules shall be available to increase wiring maximums in increments of 1640 ft. (500m).

(4) Link power wiring between stations shall not exceed 1313 ft. (400m).

e. The ACP shall support 10/100BaseTX, auto MDI/MDIX, 802.3af compliant Ethernet networking using TCP/IP, ESTA BSR E1.17 Advanced Control Networks (ACN) and ESTA BSR E1.31 (sACN) Protocols for internal communication and integration with third-party equipment.

f. The ACP shall support EIA-RS232 serial protocol for bi-directional command and communication with third-party equipment.

g. The ACP shall support two discrete ESTA DMX512A ports, configurable as input or output ports.*

(1) *When used in a Dimming Enclosure, the second port is always an output port.

h. The ACP shall provide four onboard dry contact closure inputs for integration with third-party products.

i. The ACP shall provide four onboard contact closure outputs, rated at 1A@30VDC, for integration with third-party equipment.

4. Functional

a. Capacity

(1) Shall support 1024 channels of control

(2) Shall support 2 physical DMX ports, each of which may be configured as an input or output

b. System

(1) Runtime application shall utilize support Net3 system interoperability

(2) System shall support the use of Network Time Protocol for real time clock synchronization

(3) System shall support remote firmware upload an over Ethernet connection from a connected PC running the Light Designer software or another connected processor.

(4) System shall support local firmware upload from removable media (SD Card, USB Flash Drive)

c. Diagnostics

(1) Shall output an Event log

(2) Standard log shall store a fixed-length history of recent activity

(3) Separate critical log shall only store important messages (such as boot-up settings)

d. Configuration Data

(1) Configuration Data can be uploaded over an Ethernet connection from a PC running Light Designer application

(2) Configuration Data can be retrieved from another Paradigm Processor

(3) A Paradigm Processor shall make its configuration data available for retrieval by another Processor as a backup/recovery mechanism

(4) Configuration Data shall be stored on solid-state media that can be removed to facilitate transfer between Processor units

(5) Configuration Data may be loaded to and from removable media access provided on front panel

(6) Configuration Data for the entire System shall be available for download from any single Processor

(7) Shall store configuration data for Dimming enclosure processors and shall make available for download.

e. Scalability

(1) Adding additional Processors to a System shall proportionately increase its overall capabilities up to a maximum System size

(2) The maximum number of Processors configured as a System shall be at least 12.

(3) Multiple Processors shall utilize the Ethernet network to remain time synchronized and share control information

(4) Multiple Processors shall utilize the Ethernet network to maintain configuration data synchronization as modifications are made

(5) Failure of a single Processor shall not prohibit continuing operation of the remaining Processors

(6) It shall be possible for multiple Systems to coexist on the same physical network with logical isolation between Systems

f. Local User Interface

(1) Shall provide access to Processor setup (IP address)

(2) Shall provide access to Processor status and diagnostics

(3) Where the Processor is installed within a Dimming enclosure, shall provide access to Dimming enclosure setup, status and diagnostics

(4) Shall provide control functionality for Control Channels, Zones, Fixtures, Groups, Presets, Macros, Walls and Sequences within the current configuration.

(5) Shall provide functionality to add, edit and delete astronomical and real time event schedules

(6) Shall allow for display of local DMX information

(7) Shall allow for transfer of log files to local removable media

(8) Shall allow to perform firmware upgrades for connected Dimming enclosures

(9) Shall allow for transfer of configuration to and from Dimming enclosures using removable media

(10) Shall allow for transfer of configuration to and from LCD Stations using removable media

(11) Shall allow for binding of Stations

g. Access Controls

(1) There shall be 2 user accounts - Administrator, and User with separate password protection

(2) Account and password settings shall be local to each Processor

(3) Access Controls shall be applied to certain areas of the Paradigm Local User Interface and Web Interface

h. Web User Interface

(1) Shall be accessible by SCADA

(2) Shall be an internal web server accessible via Ethernet port

(3) Shall support common web browsers on Windows and Mac platforms

(4) Shall provide functionality to Activate and Deactivate Presets

(5) Shall provide functionality to schedule timed events (add/delete)

(6) Shall have a calendar to show when events are scheduled and allow the user to schedule events up to a year in advance and for those events to be remembered and repeated on the same day annually.

(7) Shall display status information

(8) Shall display log files

(9) Shall allow for configuration of Processor settings (date, time)

(10) Shall allow for upload and download of configuration data

(11) There shall be links to other web-enabled devices in the System, including other Paradigm Processors

i. Stations

(1) Stations shall be connected to a Paradigm Processor via a LinkPower network or Ethernet

(2) Station discovery and binding shall be accomplished from the Local User Interface or Light Designer

j. Net3 and ACN Devices

(1) Net3 Devices shall be connected to and controlled from Paradigm Processors via Ethernet

(2) Paradigm Processors shall provide DMX-Net3 gateway functionality

(3) It shall be possible to send and receive Macro triggers defined within the System configuration via Net3

(4) There shall be support for Streaming ACN on up to 24 universes per Processor

k. Operation

(1) When contained in an dimming enclosure, a snapshot of the dimming enclosure output data shall be stored in persistent memory so that hardware can access it for immediate output on boot

(2) DMX output refresh rate shall be configurable

(3) There shall be support for 16-bit DMX Attributes

(4) DMX inputs may be patched to DMX and Streaming ACN outputs as external sources

(5) Streaming ACN inputs shall be patched to DMX outputs (gateway) as external sources

(6) Where there are multiple external sources then priority and HTP shall be used to perform arbitration

(7) External and internal sources shall be arbitrated based on user-selection of standard or custom rules

(8) On Preset Record, the values of Attributes within the Preset shall be updated to reflect the current output

(9) The total output may be the combination of many different Presets running concurrently

(10) There shall be no hard limit on number of concurrent cross fades

(11) Multiple Presets controlling the same Attribute shall first interact based on priority and second based on Latest Takes Precedence (LTP) or Highest Takes Precedence (HTP)

(12) LTP and HTP operation shall be supported simultaneously and interact (at the same priority) using HTP

(13) Settings due to LTP Presets may be automatically discarded from operation when overridden

(14) It shall be possible to specify that a Preset or Attribute Control will persist when overridden

(15) A Preset may be designated as an HTP Override and shall cause HTP values to be discarded

(16) It shall be possible to modify the rate of a Preset (Cross fades, Effects) from a Control within the System

(17) Each Preset shall have a status that can be Activated, Deactivated or Altered

(18) Preset status may be set based on matching levels in the current output as an option

(19) On startup the System shall be capable of automatically executing timed events within the previous 24 hours to synchronize its initial output state with the current time of day

l. Serial Input/Output

(1) RS232 shall support 8-bit word length, parity selection and 1 or 2 stop bits

(2) RS232 shall support baud rates from 4800 to 115,200 bps

(3) Serial input and output messages are fully customizable

(4) Serial output messages can be generated by any Control or Event

5. Provide

a. Unison Paradigm Architectural Control Processors for the centralized management of lighting control system as per plans and specifications. ETC Model: Unison P-ACP, or approved equal.

E. CONFIGURATION AND CONTROL SOFTWARE

1. System Configuration

a. The Architectural Control System Configuration software shall be the Unison Paradigm LightDesigner as manufactured by Electronic Theatre Controls, Inc., or approved equal.

b. Definitions

(1) A System is the configuration of one or more Paradigm Processors

(2) A Fixture is a controllable entity with one or more Attributes

(3) An Attribute is a parameter of control such as Intensity, Pan or Gobo select

(4) A Group is a selection of Fixtures that can be stored and recalled

(5) A Space is defined area where other System objects reside. A Space defines the scope of Control for other objects.

(6) A Control is a single point of input to the System (e.g. Button, Fader, Serial Port)

(7) An Indicator is a single point of feedback from the System (e.g. LED, Label on LCD)

(8) A Station has an arrangement of Controls and Indicators

(9) A Page stores the assignment of function to Controls and Indicators of a particular Station and their properties (e.g. lockout threshold)

(10) Actions are items of functionality that can occur within a running Paradigm system in response to events (e.g. button presses, timed events)

(11) Preset is a container of Attribute settings (levels) and timings that can stored and recalled

(12) A Sequence is a series of connected steps referencing Presets along with additional timing information

(13) Effects are Attribute settings that result in continually varying levels following a specified curve and using additional timing parameters (e.g. period, offset)

(14) Palette is a container of Attribute settings (levels) that can be referenced from Presets, allowing a change in the Palette to globally modify referenced Presets.

(15) Macros are user-defined operations built up as a sequence of Actions that can be recalled

(16) Binding is the process of associating a logical instance of a device within the configuration with a physical device discovered at runtime

c. Environment

(1) Shall be possible to work with multiple System configurations simultaneously

(2) There shall be clipboard functionality (cut, copy, paste) for entire objects (e.g. Presets, Stations), settings (e.g. Attribute levels) and text

(3) There shall be undo and redo functionality where persistent changes are made to the System configuration (but not application settings or playback state)

(4) There shall be a auto-backup feature

(5) The application interface shall be based around (i) a tree-view; (ii) a workspace area; (iii) a properties inspector; (iv) item selector.

(6) It shall be possible to represent data about the workspace area graphically (plan) or in tabular form

(7) Plan views shall support zoom

(8) Plan views shall support a layout grid with user-defined spacing and color with associated snap-to-grid functionality

(9) The properties inspector shall be used to view and modify the properties of one or multiple objects

(10) There shall be 2 modes of operation that expose progressively more in-depth functionality (Normal, Advanced)

(11) It shall be possible to enter User-configurable names in any language supported by their operating system (e.g. encoded as UTF8)

(12) User-configurable names shall be limited to 64 display characters each

(13) There shall be provision for help functionality to be accessed from within the application

d. System Configuration

(1) It shall be possible to create Spaces

(2) It shall be possible to add Fixtures by selecting a Fixture Template from the provided library and create custom Fixtures

(3) It shall be possible to add Stations by selecting a Station Definition from the provided library and create custom Stations

(4) It shall be possible to create a System based on data imported from a defined documentation format (e.g. CSV, XML)

(5) It shall be possible to export System configuration data to a defined documentation format (e.g. CSV, XML)

(6) There shall be a wizard to assist with the initial setup of a System including Project data entry, Space creation, network configuration, and zone creation.

(7) There shall be a straightforward process for the assignment of Fixtures and Stations to particular Processors

(8) There shall be a 2-dimensional plan view that displays the layout of Spaces

(9) A Space shall be displayed as a user-configurable polygon with straight edges

(10) The plan shall display Fixtures and Stations located within Spaces

(11) Items displayed on the plan may be arranged using standard graphical interaction methods (e.g. drag-and-drop)

(12) It shall be possible to import images JPEG, BMP and GIF formats as a background image to the plan view

(13) It shall be possible to create Walls that accomplish Room Combine between Spaces

(14) It shall be possible to import Load Schedules, Equipment Lists and Presets form a spreadsheet to automatically create system objects and configuration parameters.

e. Fixture Configuration

(1) There shall be functionality to patch Fixtures to DMX and Streaming ACN

(2) There shall be support for Fixtures with split patches (e.g. VL5)

(3) There shall be support for multiply-patching a Fixture

(4) It shall be possible to specify a minimum and maximum value for an Attribute

(5) It shall be possible to specify a minimum fade time for an Attribute

(6) It shall be possible to invert the range of values for an Attribute

(7) It shall be possible to specify a default value for an Attribute

(8) It shall be possible to specify a dimmer curve for an intensity Attribute

f. Design and Simulation

(1) There shall be a tabular view of Fixture Attributes within Spaces

(2) There shall be control of Zones (as a type of Fixture)

(3) There shall be control of LED arrays (as a type of Fixture)

(4) There shall be independent control of every Attribute of a Fixture

(5) Appropriate graphical controls shall be provided for non-intensity Attributes (e.g. color picker)

(6) It shall be possible to create Groups as a selection shortcut

(7) The plan shall show simulation feedback for Fixtures in a graphical form

(8) Feedback values for Attributes shall be displayed in terms of real-world units where an appropriate real-world unit and mapping is available (e.g. pan in degrees)

(9) Control events may be simulated by clicking on a representation of the Station in at least the plan view

(10) The simulation may be linked to the actual online System to synchronize playback and inject control events (live control)

g. Presets

(1) There shall be provision to record a Preset based on current Attribute settings

(2) There shall be a display of Presets that affect Fixtures in the Space being worked with and their activation status

(3) A Preset may store a reference to a Palette as an Attribute setting

(4) Presets may be displayed and modified in tabular form (spreadsheet)

(5) Timing in Presets may be set on an individual Attribute basis

(6) Timing settings shall include a fade time, a delay time and a fade profile

(7) All Presets may include split timing

(8) Presets may be applied in an Latest Takes Precedence (LTP) or Highest Takes Precedence (HTP) manner

(9) It shall be possible for all Presets to include Effects

(10) Each Effect shall have a Curve and parameters (to include size, period, offset and repeat count)

(11) There shall be support for a flicker effect

(12) There shall be a provision to create Sequences from Presets

(13) It shall be possible for a Sequence to be displayed and modified as a timeline display

(14) It shall be possible for any step of a Sequence to trigger a defined Action

(15) The end state of a Sequence shall be user configurable (e.g. release, loop, hold at end)

h. Stations and Events

(1) Can assign functionality (Actions) to Controls and Indicators on a Page for a particular Station

(2) Stations may have multiple Pages that can be switched between at runtime

(3) Controls shall have a configurable event handler (Script) that determines the nature of the control (e.g. momentary vs. maintained button)

(4) Actions initiated from a Station shall, by default, be restricted to affecting the Space containing the Station

(5) A Control may be configured so that the Actions it triggers behave as if initiated from a specified Space anywhere in the System

(6) Controls shall have a priority that is used when performing operations (e.g. preset activation, fader attribute control)

(7) It shall be possible to specify timed events (including repeat intervals hourly, daily, weekly, etc.)

(8) It shall be possible to specify astronomical timed events up to a year in advance on the calendar and have them repeated annually.

(9) Serial (e.g. RS232, Ethernet) input data shall be treated as a Control event and shall be handled through use of Script (standard or custom)

(10) There shall be Override functionality that can be applied to any Control or Event

(11) There shall be Lock Out functionality for Controls using 3 distinct lockout variables

(12) Direct control of Attributes can be assigned to Controls (e.g. buttons, faders)

(13) Mastering of Intensity for Fixtures, Groups or Presets can be assigned to Controls

(14) There shall be extensible support for third-party LonMark devices

(15) A physical Lon native Station that is portable may automatically bind to different logical Stations within the configuration based on an established physical LON connection

(16) There shall be an option to assign default functionality to Controls and Indicators of a Station automatically when it is added to the configuration and update it as the configuration changes

(17) There shall be an option to generate a graphical configuration for an Touchscreen automatically based on the current configuration and update it as the configuration changes

(18) It shall be possible to import .ics files for display of holidays or other notable dates

i. Actions

(1) There shall be a standard Action for toggling the Intensity Attribute of a Fixture or Group (Fixture Toggle)

(2) There shall be standard Actions for recalling Presets (Preset Recall)

(3) There shall be a standard Action for recording a Preset (Preset Record)

(4) There shall be standard Actions for controlling Sequences (Timeline Control)

(5) There shall be standard Actions for changing Wall state (Wall Toggle)

(6) There shall be a standard Action for raising or lowering the intensity setting of a Fixture or Group

(7) There shall be a standard Action for raising or lowering the intensity setting of a Preset

(8) There shall be a standard Action that activates Faders within its scope (Manual)

(9) There shall be a standard Action that activates Faders on a target station and locks out other Stations within its scope (Take Control)

(10) There shall be a standard Action for setting lock out variables for a Station, within a Space or System-wide (Lock Out)

(11) There shall be a standard Action for enabling and disabling Overrides

(12) There shall be a standard Action for recalling a Macro (Call Macro, Macro Toggle)

(13) There shall be a standard Action for turning Off a particular Fixture, Group or Fixtures within a Space (Off)

(14) There shall be a standard Action for controlling Fixture or Group Intensity levels from a Fader

(15) There shall be a standard Action for controlling Preset Intensity levels from a Fader

(16) There shall be a standard Action for mastering Fixture or Group Intensity levels from a Fader

(17) There shall be a standard Action for modifying Preset fade times from a Fader

(18) There shall be a standard Action for modifying Preset rate from a Fader

(19) There shall be an equivalent standard Indicator behavior for every standard Action

(20) Qualified users may create custom Actions

j. Macros

(1) Users can create, store and recall Macros that are sequences of Actions (standard or custom)

(2) Macros may define separate sequences to occur when turned on and off (toggle)

(3) Macros may incorporate conditional statements based on current status of the System (e.g. comparisons such as x > y)

(4) Conditional statements may be combinations of several simpler statements using logical operators (AND, OR)

k. Script

(1) There shall be a mechanism for defining custom functionality using a scripting language

(2) The behaviors of Controls and Indicators may be customized through the use of Script

(3) Script may be used to define custom functionality (Actions) within the System

(4) Script shall allow new functionality to be defined in a manner that is reusable in different Systems

(5) Script shall support logical and arithmetic operations

(6) Script shall support direct access to System data using names

(7) Script shall support creating, reading and writing to persistent System-wide variables (registered variables)

(8) Script shall support timer functionality including the capability to cancel a running timer

(9) Script shall support logging functionality

(10) Standard functionality may be implemented as Scripts that will not be user modifiable

(11) A Custom Script may be copied from a suitable Standard Script to provide a starting point

(12) Script shall support reading data directly from connected interfaces (e.g. LON NVs, ACN properties, DMX inputs)

(13) Script shall support writing data directly to connected interfaces (e.g. LON NVs, ACN properties, DMX outputs, Serial ports)

(14) Script shall allow parsing of data (e.g. reading 8 contact inputs as individual bits from a byte of data)

l. Network

(1) Shall display a topological view of Paradigm Processors and connected Stations

(2) Can associate a particular Station with a Paradigm Processor

(3) Shall report online status of Paradigm Processors and Stations

(4) Shall allow for configuration of network properties (IP) of Paradigm Processors

(5) Shall allow for upload of configuration data to all or individual Paradigm Processors

(6) Shall allow for download of configuration data from Paradigm Processors

(7) Shall allow for download of logging data from Paradigm Processors

(8) Shall provide for performing firmware upgrades to Paradigm Processors

(9) Shall allow to perform firmware upgrades for Dimming enclosures using Paradigm Processors as proxies

(10) Shall allow for transfer of configuration to and from LCD Stations using Paradigm Processors as proxies

(11) Shall allow for discovery and binding of Stations

(12) There shall be a mode in which configuration changes are propagated to Processors as they occur without interrupting operation (live edit)

m. Reports

(1) It shall be possible to generate tabular reports and customize their layout and appearance

(2) It shall be possible to print reports

(3) It shall be possible to export reports to file (e.g. CSV)

(4) There shall be reports for Presets

(5) There shall be reports for Fixtures

(6) There shall be reports for Stations

(7) There shall be reports for Processors

(8) There shall be reports for Macros

n. Resources

(1) Effect Curves, Fade Profiles and Dimmer Curves shall use a common format and allow custom variants to be generated by the user

(2) Additional Fixture Templates may be defined by the user (custom Fixtures)

(3) Additional Station Definitions may be defined by the user (custom Stations)

2. Touchscreen Station Configuration

a. The Architectural Control System Touchscreen Configuration software shall be the Unison Paradigm ControlDesigner as manufactured by Electronic Theatre Controls, Inc., or approved equal.

b. The Unison Paradigm ControlDesigner software program shall be an application software package that facilitates off-line Unison Paradigm Touchscreen station configuration.

(1) Software setup shall include Configuration and Design Wizards, to create a graphical representation of a control environment.

(2) The software program shall be downloadable from the manufacturer's website free of charge.

c. Functions

(1) Provides functionality to create and modify Pages for display on a specific type of LCD Station

(2) There shall be a wizard to assist with the creation of Pages

(3) A single configuration for an LCD Station shall be defined as a set of one or more Pages

(4) Each Page shall have a background that may incorporate multiple images or animations

(5) Pop-ups can be shown/hidden over any Page in a Configuration and more than one Popup can be shown at once

(6) Pages may have multiple design elements that may be Controls, Indicators or both

(7) Design elements shall have a user-defined size, position and z-order that cannot be changed from within the System

(8) Each design element shall have between 1 and 256 states, each of which can have a distinct appearance

(9) The appearance of a state can be taken from a Theme or imported image file

(10) There shall be support for import of at least JPG, PNG and GIF image formats

(11) Transparency shall be supported

(12) Animated images shall be supported

(13) Transitions between states of design elements can be animated

(14) Page transitions can be animated

(15) Design elements shall have a visibility group and threshold

(16) Design elements that are Controls shall have a lockout group and threshold

(17) All text shall have a user-definable font family, size, color and alignment

(18) There shall be at least the following types of design element

(a.) Label

(b.) Level Indicator

(c.) Button

(d.) Fader (straight and curved)

(e.) Clock (analogue and digital)

(f.) Numeric Keypad

(g.) Tab widget

(h.) Color Picker

(i.) Error table

(19) Themes shall define a collection of consistent appearances and sounds for design elements

(20) It shall be possible to change the Theme used for a particular Station without modifying the underlying design elements

(21) There shall be tools to assist with the creation of new Themes

(22) Shall allow sounds to be associated with a particular Page

(23) Shall allow sounds to be associated with state transitions of particular design elements

(24) Sounds may be used to provide Touchscreen interaction feedback

(25) A Page can be designated as the Stations inactivity Page

(26) A Page can have a lockout group and threshold

(27) A Tab can have a visibility group and threshold

(28) There shall be a visualization interface for Page creation and editing

(29) Standard graphical interaction methods (drag-and-drop) shall be used to arrange design elements on Pages

(30) There shall be a layout grid with user-defined spacing and color with associated snap-to-grid functionality

(31) It shall be possible to reuse the graphical layout of a configuration independent of any assigned functionality

(32) The LCD Design functionality shall be part of a separate application that can be used alongside Light Designer

(33) Pop-ups can be any fixed size up to the Page size

(34) Pop-ups will have a fixed position on screen (but may move when being shown/hidden)

3. Minimum Computer Requirements

a. The software shall require the Windows XP SP2 (Home or Pro) operating system running on a x86-Windows-compatible computer (2 GHz Pentium 4 or better) with a minimum of 1 GB of hard drive space and 1 GB RAM, OpenGL graphics acceleration, a monitor capable of displaying at least 1024 x 768 screen resolution, a CD-ROM optical drive, Ethernet port, USB port or SD card slot, keyboard and mouse.

4. Provide

a. Programming services and timed event scheduling via specified software.

F. TOUCHSCREEN CONTROL STATION

1. The Touchscreen Control Stations shall be the Unison Paradigm Touchscreen P-LCD Series Control Stations as manufactured by Electronic Theatre Controls, Inc., or approved equal.

2. General

a. Touchscreen stations shall support default and fully graphical control pages.

b. The Touchscreen station shall operate using graphic buttons, faders and other images on at least 30 separate programmable control pages.

c. Touchscreen stations shall also allow programming of page pass-code, lock out and visibility levels.

3. Mechanical

a. Touchscreen stations shall consist of a seven inch, backlit liquid crystal display (LCD) with a minimum resolution of 800 by 400 pixels and 12-bit color depth with a touch interface.

b. Touchscreen bezels shall be constructed of aluminum and shall have no visible means of attachment.

(1) The bezel shall install and remove without the use of tools.

(2) The bezel shall provide two working positions for the Touchscreen: service and operating.

c. The Touchscreen shall have a protective overlay over the display.

(1) The overlay shall reduce wear

(2) The overlay shall reduce glare

d. The manufacturer shall provide rack-mounting kits for all LCD stations.

4. Electrical

a. Touchscreens shall be powered entirely by the System network.

b. Touchscreens shall connect to the System using an Ethernet network with Power over Ethernet (PoE) or the Unison control station Echelon® Link power network.

(1) Ethernet Network

(a.) Ethernet network shall be 10/100BaseTX, auto MDI/MDIX, 802.3af compliant.

(b.) Network shall utilize Unshielded Twisted Pair (UTP) Category 5 wiring.

(2) Echelon® Link power network.

(a.) Link power shall utilize low-voltage Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).

(b.) Touchscreen stations shall also require (2) #16 AWG stranded wires for 24Vdc operating power. 24Vdc wiring shall be topology free.

(c.) Network wiring may be bus, loop, home run, star or any combination of these.

(d.) Network insulation displacement connectors shall be provided with all stations.

5. Functional

a. System

(1) The Touchscreen shall support configuration firmware upload from a Paradigm Processor as proxy

(2) The Touchscreen shall support configuration or firmware upload from local removable media

b. Setup Mode

(1) There shall be a setup display that is separate from any user-defined configuration

(2) It shall be possible to view and modify connectivity settings

(3) It shall be possible to view status information

(4) It shall be possible to view and modify LCD screen settings

(5) It shall be possible to perform Touchscreen calibration

(6) It shall be possible to view and modify audio settings

(7) The appearance of the setup display shall be standard and not editable

(8) The setup display may be invoked from within the user-defined configuration and/or physical button on the Touchscreen

(9) There shall be a default protected method to invoke the setup display

c. Configurations

(1) It shall be possible to have multiple configurations stored within an LCD Station

(2) Only one configuration may be active on the LCD Station

(3) It shall be possible for Touchscreen Stations connected via the Echelon® Link power network to select a configuration automatically based on the configuration of the physical connection.

(4) Where multiple configurations are stored there shall be a boot menu to allow selection of a configuration

(5) Each configuration shall be identified as a different Station within the System

d. Operation

(1) The Unison Paradigm Control System shall be designed to allow control of lighting and associated systems via Touchscreen controls. System shall allow the control of presets, sequences, macros and time clock events.

(a.) System presets shall be programmable via Button, Button/Fader, Touchscreen, or LightDesigner software.

i. Presets shall have a discrete fade time, programmable from zero to 84,600 seconds with a resolution of one hundred milliseconds.

ii. Presets shall be selectable via Touchscreen stations.

(b.) System macros and sequences shall be programmable via LightDesigner system software.

i. Macro and sequence steps shall provide user selectable steps, and allow the application of conditional logic.

ii. Macro and sequences shall be activated by button, time clock event or LightDesigner software.

(c.) System time clock events shall be programmable via the Touchscreen, LightDesigner system software, the processor user interface, or the internal web server.

A Color picker, supporting Hue, Saturation and Brightness (HSB) color selection shall be available for color selection of color changing fixtures and provide visual feedback of the current color produced by the associated fixture.

i. The color picker shall be provided with a default layout that requires no user configuration

ii. The Color Picker shall provide RGB faders in addition to the default HSB color wheel for color selection

iii. Color picker values shall allow for numerical value input in addition to color wheel and fader control

iv. The color picker shall be compatible with color mixing systems that use up to seven discrete color control channels

(2) Touchscreen stations shall be designed to operate standard default or custom system functions. Components shall operate default functions unless re-assigned via LightDesigner, the Windows-based configuration program.

(a.) Optional button functions include: preset selection, manual mode activation, record mode activation, station lockout, raise, lower, macro activation, and cue light, or room join/separate.

(b.) *Optional fader functions include master control, individual channel* control, fade rate control or preset master control.

(3) Touchscreen stations shall allow programming of station and component electronic lockout levels via LightDesigner.

(4) It shall be possible to adjust LCD contrast and brightness.

(5) It shall be possible to program the station to dim during periods of inactivity.

6. Provide

a. LCD Touchscreen station and mounting equipment as per plans and specifications. ETC Model: Unison P-LCD-RM, or approved equal.

G. STATION POWER MODULE

1. The Station Power Module shall be the Unison Paradigm P-SPM Series Station Power Module as manufactured by Electronic Theatre Controls, Inc., or approved equal.

2. Mechanical

   a. The Station Power Module (SPM) assembly shall be designed for use in DRd Series or ERn Rack Enclosures.

   b. The SPM shall convert input power into low-voltage (Class II) power with data line and a secondary auxiliary low-voltage line to energize button, button/fader, touchscreen, and interface devices for multi-scene lighting and building control.

   c. SPM module shall be contained in a plug-in assembly.

      (1) The module shall be housed in a formed steel body and contain no discrete wire connections.

         (a.) No tools shall be required for module removal or insertion.

   d. The SPM shall be convection cooled without the use of fans,

   e. User Interface

      (1) The SPM shall utilize light emitting diodes (LED's) to indication function, status and fault.

   f. The SPM shall be secured behind the locking door.

   g. Wall-mounted, direct wire and 19" rack-mount, connectorized repeater and dual-repeater variants shall be available from the same manufacturer where required on the project.

3. Electrical

   a. The SPM shall require no discrete wiring connections; all wiring shall be terminated into the dimming enclosure, unless required by a variant.

   b. The SPM shall require line-voltage power supplied by the Contractor, terminated inside the dimming or control enclosure.

   c. The SPM shall be hot-swap capable.

   d. The SPM, in conjunction with a matching Architectural Control Processor (ACP), shall support Echelon LinkPower communications with remote devices, including button, button/fader, touchscreen and interface stations, and shall interoperate with LonMARK-approved third-party devices.

      (1) The LinkPower network shall utilize polarity-independent, low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded) or equivalent. One # 14 AWG drain wire will be required for system not using grounded metal conduit.

      (2) The LinkPower network shall be topology free. Network wiring may be bus, loop, home run, star or any combination of these.

      (3) Link power wiring shall permit a total wire run of 1640 ft. (500m)

         (a.) Repeaters allow an additional wire run of 1640 ft. (500m)

         (b.) Dual-repeaters allow two additional wire runs of 1640 ft. (500m)

(4) Link power wiring between stations shall not exceed 1313 ft. (400m).

e. The SPM shall support auxiliary power for certain remote devices, including touchscreen and interface stations, as required by the device.

(1) The auxiliary power network shall utilize polarity-dependent, low-voltage Class II wiring, consisting of two # 16 AWG wires.

(2) Auxiliary wiring shall permit a total wire run of 1640 ft. (500m)

(a.) Repeaters allow an additional wire run of 1640 ft. (500m)

(b.) Dual-repeaters allow two additional wire runs of 1640 ft. (500m)

(3) The SPM shall supply 1.25 amps at 24v DC continuously.

4. Functional

a. Capacity

(1) Each SPM shall:

(a.) Supply power for up to 32 button and button/fader stations.

i. Repeaters and dual-repeaters allow 30 additional stations, 62 total

(b.) Supply auxiliary power for a similar number of interface stations.

(c.) Shall supply auxiliary power for up to four Touchscreen stations, when a like number of other stations are deducted from the total

i. Repeaters and dual-repeaters allow two additional Touchscreens (six total) when a like number of other stations are deducted from the total.

b. Operation

(1) The SPM shall not require configuration or programming.

(2) The SPM shall automatically detect faults in the wiring, indicate the fault, including the fault polarity, and shut down the output power.

(a.) The SPM shall automatically reset when the fault is clear, and can be manually reset by removing and re-inserting the module.

H. CONTROL ENCLOSURES

1. The control enclosure shall be the Unison ERn Series Control Enclosure as manufactured by Electronic Theatre Controls, Inc., or approved equal.

2. Mechanical

a. The External Processing enclosure shall be a surface mounted panel constructed of 18 gauge formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter.

(1) The enclosure door shall have an opening to allow limited access to the control module face panel.

(2) Enclosures shall be convection cooled without the use of fans.

b. Control Enclosures shall be sized to accept one Control Processor and one Station Power Modules, including various options and accessories.

(1) The Control Enclosure for a single control processor (ERn2) shall support a single Station Power Supply module.

c. All enclosure components shall be properly treated and finished.

(1) Exterior surfaces shall be finished in fine textured, scratch resistant, powder based epoxy paint.

d. Enclosure(s) shall be available in a 19" rack mounted (RM) version.

(1) Rack-mounted version shall have an independent enclosure suspension kit, with a full height, locking door/cover attached to the kit.

e. Rack-mounted version shall have an opening to access the control module face panel, and openings to view indicators on option modules. Enclosure dimensions and weights (without modules) shall not exceed:

(1) ERn2-RM - 19" W 11"H 10" D, 20 lb.

f. Top, bottom, and side knockouts shall facilitate conduit entry.

g. Enclosures shall be designed to allow easy insertion and removal of all control and option modules without the use of tools.

(1) Supports shall be provided for precise alignment of modules into power and signal connector blocks.

(2) With modules removed, enclosures shall provide clear front access to all power and control wire terminations.

h. Option Modules

(1) Ethernet Switch

(a.) The Control Enclosure shall support an optional 5-port Ethernet Switch, with at least 4 ports supplying Power over Ethernet (PoE).

(b.) The Ethernet Switch module shall be 100BaseTX, auto MDI/MDIX, 802.3af PSE compliant.

(c.) The Ethernet Switch module shall contain power, status, and activity indicators. All indicators shall be visible when the enclosure door is open for both rack and wall mounted ERn.

(2) Redundant Power Supply (RRPS)

(a.) The Control Enclosure shall support an optional redundant power supply which shall automatically provide power to the control electronics upon failure or removal of the primary power supply.

(b.) The redundant power supply shall assert itself seamlessly without a loss of power to the control electronics.

(c.) The redundant power supply shall seamlessly remove itself when the primary power supply is reengaged.

(d.) The redundant power supply shall provide visible indication that it is active.

i. Accessories

(1) BatteryPack Option (BPO)

(a.) The Control Enclosure shall support an optional, long-term back-up power source for the control electronics.

(b.) The long-term back-up power source shall automatically engage upon the loss of normal power, seamlessly transitioning the supply power for the control electronics power to itself.

(c.) The long-term back-up power source shall supply power to the control electronics for at least 90 minutes.

(d.) The long-term back-up power supply shall detect the return of normal power, and seamlessly return the control electronics to normal power.

(e.) A test switch/indicator shall be available without opening the rack door or removal of any modules/components

3. Electrical

a. External Processing enclosures shall be available in 100, 120, 230 and 240 volt, single-phase configurations.

b. External Processing enclosures shall be completely pre-wired by the manufacturer. The Contractor shall provide input and control wiring.

c. External Processing enclosures shall be designed to support the following wire terminations:

(1) AC (single phase)

(2) Echelon link power (Belden 8471 or equivalent)

(3) 24Vdc (2- 16AWG Wire)

(4) DMX512A Port A (In or Out) (Belden 9729 or equivalent)

(5) DMX512A Port B (In or Out) (Belden 9729 or equivalent)

(6) RS232 Serial In/Out (Belden 9729 or equivalent)

(7) Unshielded Twisted Pair (UTP) Category 5 Ethernet

(8) Contact Closure In (14AWG to 26AWG Wire)

(9) Contact Closure Out (14AWG to 26AWG Wire)

(a.) Contact Closure Out shall provide 1A @ 30vDC

d. Station Power Modules

(1) Station power supply modules shall provide LinkPower for at 32 stations and 1.5A@24VDC of Auxiliary (AUX) power.

(2) Station power repeater modules shall provide LinkPower for 30 stations and1.5A@24VDC of Auxiliary (AUX) power.

(3) Station power module shall support over-current/short protection for LinkPower and Aux. LinkPower shall support fault detection on each leg of the balanced data bus.

e. All control wire connections shall be terminated via factory provided connectors.

4. Thermal

a. Ambient room temperature: 0-40°C / 32-104°F

b. Ambient humidity: 10-90% non-condensing

5. Provide

a. Rack mounted control enclosures and options and accessories as per plans and specifications. ETC Model ERn2-RM-120 or approved equal.

I. 8-PORT DMX/RDM GATEWAY NODE

1. General

a. Provide eight-port DMX nodes to permit DMX512 and RDM data to be encoded, routed and decoded over a conventional 10/100Base-T Cat5 (twisted pair copper) Ethernet network.

b. Each node shall incorporate eight (8) gold-plated 5-pin front or rear-mounted XLR-type female connectors, or eight (8) Phoenix-type rear-mounted screw terminal connectors, or eight (8) EtherCon™ rear-mounted RJ-45 female connectors for DMX/RDM ports.

c. Each node shall also incorporate one external 10/100 Ethernet port utilizing a rear-mounted EtherCon™ RJ-45 type female jack.

d. Nodes shall incorporate a manual user interface consisting of an encoder knob with integral pushbutton and a backlit graphical LCD display for identification (soft-labeling) and status reporting. Labeling shall be user configurable.

e. Nodes shall be capable of encoding or decoding DMX data to or from any industry standard Ethernet lighting control protocol and certain commonly used proprietary Ethernet protocols.

2. DMX Ports

a. DMX ports shall comply with the requirements of the ANSI E1.11 DMX512-A standard, and the USITT DMX512 (1990) standard.

b. DMX ports shall be fully electrically isolated from the Ethernet network infrastructure and chassis ground.

c. DMX ports shall be capable of being user-configured as inputs, outputs or not used (available).

d. Each DMX port shall include three front panel LEDs to indicate port direction, data activity and isolated power status.

e. The DMX output update (refresh) rate shall be user-selectable between rates of 31Hz, 36Hz, 40Hz, and 44Hz (maximum possible rate). The update rate shall be user selectable on a port-by-port basis.

f. DMX ports configured as outputs shall support ANSI E1.20 RDM (Remote Device Management).

g. DMX ports shall provide connections for signal common, the primary data pair, and connection points only for the secondary (optional) data pair.

3. Ethernet Port

a. The Ethernet port shall comply with the requirements of the IEEE 802.3 10/100Base-T standard.

b. The Ethernet port shall include LED indicators for Link status and 10/100 speed status.

4. Processor

a. Each node shall have sufficient processing power to merge up to eight (8) incoming DMX universes with respect to each output port.

b. The CPU shall be capable of processing up to sixteen (16) megabits per second of network traffic without any dropped packets.

c. Maximum delay time from input to output shall not be greater than one DMX *packet time (approximately 30 mSec.).*

d. Node firmware shall be stored in non-volatile (Flash) memory. It shall be possible to upload new firmware files via the Ethernet port.

5. Mechanical

a. The node housing shall be constructed of die-cast aluminum and steel.

b. Nodes shall be of pleasing appearance, suitable for high-visibility locations.

c. Nodes shall be designed to mount in a single rack unit of height and shall include all necessary mounting hardware for this purpose.

d. Nodes shall be provided in satin black textured powder-coat finish.

6. Electrical

a. The power supply shall be a field-replaceable, wide-range input (85-264VAC, 50/60Hz) switching power supply. There shall be no power switch to reduce chances of being shut off in error.

b. There shall be 4000-volt electrical isolation between mains power supply and low voltage circuits.

c. There shall be 2500-volt electrical isolation between adjacent DMX I/O sections.

d. Each DMX I/O port shall be capable of withstanding the continuous application of up to 48V, and transient application of up to 250V, without damage to internal components. Protection shall be of a self-resetting type, rated for 250V. Replaceable fuses are not acceptable.

7. Configuration

a. Node identification (naming), DMX port direction, universe patching and all other configuration shall be accomplished using a personal computer connected to the Ethernet port. The node manufacturer shall provide the configuration software for this function (see Section 10).

b. All nodes on the same network shall be remotely configurable from a personal computer connected to the Ethernet network.

c. Once configuration is done, the nodes shall not require a computer to be present on the network for proper operation.

d. All configuration and operational data shall be stored in non-volatile memory in each node.

e. It shall be possible for a personal computer connected to the Ethernet network, to download from a system of all connected nodes, all their configuration and operational data, such that a complete new system configuration file can be created and saved in the computer.

f. It shall be possible to make configuration changes at any time during live performance without interrupting or otherwise adversely affecting the flow of DMX data through the system, with the exception of the specific port(s) directly affected by the changes.

8. DMX Routing

a. It shall be possible for the user to route complete DMX universes from any input port to any DMX output port at any node. It shall be possible to route universes to any number of nodes. Routing shall be configured from a personal computer running the configuration software.

b. It shall further be possible to route individual DMX channels (or ranges of channels) from any input port to any output port. Routing shall be configured from the configuration software.

c. It shall be possible to merge whole universes or individual DMX channels to any output port.

d. It shall be possible to prioritize input universes or individual channels routed to any output port..

e. Where two or more control sources are prioritized with respect to a given DMX channel or universe, the system shall be capable of cross-fading between sources as they are

f. The computer shall only be required for configuration and signal routing assignment, and shall not be required for the normal operation of the system.

g. All relevant routing information shall be stored in non-volatile memory at each node. The system shall recover from a power outage without requiring a computer to be online.

9. Network

a. Communications physical layer shall comply with the IEEE 802.3 10/100Base-T Ethernet specification. Products offering only 10Base-T connectivity shall not be acceptable.

b. All network cabling shall be Cat5, Cat5e or Cat6 conforming to TIA-568A/B, and shall be installed and certified by a qualified network installer.

c. Data transport shall utilize the TCP/IP suite of protocols to transfer the DMX and RDM data.

d. Nodes shall support industry standard ANSI E1.31 Streaming ACN.

e. Nodes shall also support ETCNet3, Pathport Protocol, Art-Net, and Strand ShowNet.

f. Nodes shall be capable of accepting DMX level data from any or all of the above named protocols simultaneously.

10. Management Software

a. Provide and install node management software to allow the user to discover, configure and monitor all nodes in the system.

b. The software shall be capable of managing individual nodes or all installed nodes in the system simultaneously.

c. Software that can manage only one node at a time shall not be acceptable.

d. The software shall provide an intuitive graphical user interface for all configuration and monitoring functions.

e. The software shall include an RDM master controller function.

f. The software shall provide a comprehensive log of all user-initiated and system-generated status and error messages to aid in troubleshooting.

g. The software shall include password protection to prevent unauthorized access.

h. The software shall be compatible with Windows, Macintosh and Linux operating systems.

11. System Requirements

a. Provide the quantity and type of nodes required, as indicated on the drawings and schedules.

b. Provide Ethernet switches as shown on the drawings and schedules.

c. Provide system management software as described in Section 10.

12. Compliance

a. The DMX/RDM Gateway nodes shall be compliant with the RoHS directive.

b. The DMX/RDM Gateway nodes shall conform to all FCC and CE requirements.

c. The DMX/RDM Gateway nodes shall be tested by a National Recognized Testing Laboratory.

13. Warranty

a. The manufacturer shall warrant the DMX/RDM Gateway nodes to be free of defects in materials and workmanship for a period of not less than two (2) years from the date of final acceptance by the customer.

b. The manufacturer shall provide any and all software and firmware updates to the customer free of charge for a period of not less than five (5) years from the date of final acceptance.

14. Provide

a. The nodes shall be Pathway Pathport® OCTO 8-Port DMX/RDM Gateway Model #640X or approved equal.

b. The management software shall be Pathway Pathport Manager Version 5 or later.

J. NETWORK SWITCH WITH POWER OVER ETHERNET (PoE)

1. General

a. Provide Managed Ethernet Switches to permit interconnection of node devices, over a conventional 10/100/1000Base-T (twisted pair copper) Ethernet network.

b. Switches shall be designed to fulfill the unique network performance requirements of the Entertainment Technology industry, specifically in their ability to maximize data throughput, and minimize packet latency and dropped packets.

c. Each Managed Ethernet Switch shall incorporate ten (10) RJ45-type front-mounted female receptacles for twisted pair (copper) connectivity.

d. Each Switch shall incorporate one (1) SFP (mini-GBIC) type rear-mounted socket, for an optional fiber transceiver module.

e. Each Switch shall also incorporate a manual user interface consisting of an encoder knob with integral pushbutton and a backlit graphical LCD panel for identification, status monitoring and basic configuration.

f. All Switch management features shall be accessible to the user via an intuitive Web interface. This user interface shall be designed to accommodate a novice user.

g. Switches shall be capable of advanced data management of any industry standard Ethernet lighting control protocol and certain commonly used proprietary Ethernet protocols.

h. Switches shall be compatible with the AVB (Audio-Video-Bridge) standard.

i. Switches utilizing cooling fans shall not be acceptable.

2. Front Panel Ethernet Ports

a. Ethernet ports shall comply with the requirements of the IEEE 802.3 standard.

b. Ethernet ports shall be capable of operating at 10Base-T, 100Base-TX and 1000Base-TX.

c. All Ethernet ports shall be capable of being user configured and monitored.

d. Each front panel Ethernet port shall provide an RJ45-type EtherCon™ female connector.

e. Each Ethernet port shall include two adjacent LEDs to indicate Link Status and Activity, and PoE status (PoE active, inactive and error).

3. Rear Panel Ethernet Port

a. The rear panel Ethernet port shall be for fiber-optic connectivity and shall be provided by an optional SFP (mini-GBIC) module.

b. Fiber Ethernet ports shall be capable of operating at 1000Base-LX or 1000Base-SX.

c. The Ethernet port shall include LED indicators for Link Status, Activity and Module Detect.

4. Switch Fabric

a. Each switch port shall be capable of being configured to limit incoming packets (ingress rate limiting), allow unlimited traffic, or to be disabled completely.

b. The switch shall incorporate features specifically designed to handle Denial of Service attacks.

5. Management Features

a. Threshold control and enable/disable of broadcast message storm filtering.

b. QoS (CoS) control by port, tagged frames, source or destination MAC.

c. Rapid Spanning Tree Protocol (RSTP) support [IEEE 802.1D-2004]

d. Virtual LAN support including MSTP [IEEE 802.1Q]

e. Line quality monitoring, using TDR

f. Diagnostic features, including loopback, port mirroring, etc.

g. Multicast support including IGMP "snooping"

h. Internet Protocol suite features: TCP, UDP, ICMP, and DHCP client and server

i. DHCP server capability shall be disabled by default but can be enabled via a user setting

j. Ability to perform a "packet capture" of at least 16 Mbytes of traffic present at a user-selected port. The packet capture shall be stored in the removable SD Card or USB drive.

6. Configuration

a. Switch identification (name and IP address) and all other configuration shall be accomplished using a personal computer or similar device running a Web browser.

b. Once configuration is completed, the Switch shall not require a computer to be present on the network for proper operation.

c. All configuration and operational data shall be stored in non-volatile memory.

d. It shall be possible to make basic configuration changes from the front panel user interface.

e. Switches shall support industry standard ANSI E1.17 ACN (Architecture for Control Networks) and ANSI 1.31 Streaming ACN.

f. Switches shall also recognize ETCNet2, ETCNet3, Pathport Protocol, ArtNet, and Strand ShowNet for the purpose of custom filtering on a per port basis.

7. Power-Over-Ethernet (PoE)

a. All ten front panel Switch ports shall be capable of providing power to connected node devices as per the IEEE 802.3af standard.

b. A minimum of sixty (60) watts of total PoE power shall be available to connected nodes. The Switch shall be capable of allocating PoE power in an intelligent fashion so as to make the most efficient use of the available capacity.

c. PoE availability to each port shall be prioritized so that higher-power peripherals can use up to the maximum permitted under IEEE 802.3af.

d. PoE power shall be denied to a newly connected device if its power, based on its PoE classification level, will cause the total PoE power to exceed the maximum.

e. It shall be possible for the user to enable or disable power availability at any port(s).

f. It shall be possible for the user to set the maximum allowable PD (powered device) power classification on a per-port basis.

g. An auxiliary PoE power input jack shall be provided on the rear panel. This shall permit the connection of up to 100 watts of additional power as required by the application.

8. Management Web Interface

a. The Switch management software shall incorporate a Web server to allow the user to configure and monitor all Switch functions and features from a personal computer connected to any port.

b. The Web server shall provide an intuitive graphical user interface for all supported configuration and monitoring functions.

c. The software shall provide a comprehensive log of all user-initiated and system-generated status and error messages to aid in network optimization and troubleshooting.

d. The Web server shall include password protection to prevent unauthorized access.

9. Front Panel User Interface

a. Provide a graphical LCD panel and encoder knob to permit the user to configure and monitor certain Switch functions.

b. The unit's name (soft label) shall be displayed on the "home" screen.

c. It shall be possible to view and edit the unit's IP address, subnet mask, and default gateway.

d. It shall be possible to view the status of each Ethernet port, including port name (soft label), link characteristics and traffic statistics.

e. It shall be possible to view the node name and IP address of nodes connected to the Ethernet ports, if such support is provided by those nodes.

f. It shall be possible, via the Web interface, to prevent an unauthorized user from making any changes to the Switch configuration from the front panel user interface.

10. External Removable Media Connectors

a. One (1) USB host connector shall be provided on the rear panel.

b. One (1) SD card slot shall be provided on the rear panel. The SD connector shall support both SD and SDHC cards.

c. External removable media, either USB memory stick or SD card devices, shall allow the user to save and load configuration files, save log files and packet captures, and upgrade firmware using only the front panel LCD/encoder interface (without a network connection).

11. Mechanical

a. The Switch housing shall be constructed of a cast aluminum shell and sheet aluminum face panels.

b. The Switch shall be designed to withstand rough handling and usage without damage to the housing or internal components.

c. Switches shall be of pleasing appearance, suitable for high-visibility locations.

d. Switches shall be designed to mount in a single 19" rack unit of height and shall include all necessary mounting hardware for this purpose.

e. The Switch housing shall be finished in satin black textured powder-coat.

12. Electrical

a. The power supplies shall be field-replaceable, wide-range input (85-264VAC, 50/60Hz) switching power supplies. There shall be no power switch to reduce the chance of being shut off in error.

b. There shall be 4000 volt electrical isolation between mains power supply and low voltage circuits.

c. There shall be 1500 volt electrical isolation between adjacent Ethernet port sections and between each port and chassis ground.

13. Compliance

a. The Pathway Pathport® VIA 10-Port+1 Managed Ethernet Switch shall be compliant with the RoHS directive.

b. The Pathport® VIA 10-Port+1 Managed Ethernet Switch shall conform to all FCC and CE requirements.

c. The Pathport® VIA 10-Port+1 Managed Ethernet Switch shall be ETL-approved.

14. Warranty

a. The manufacturer shall warrant the Pathway Pathport® VIA 10-Port+1 Managed Ethernet Switch to be free of defects in materials and workmanship for a period of not less than two (2) years from the date of purchase.

b. The manufacturer shall provide any and all software and firmware updates to the customer free of charge for a period of not less than five (5) years from the date of purchase.

15. Network

a. Communications physical layer shall comply with the IEEE 802.3 10/100/1000Base-T Ethernet specification. Products offering only 10/100 connectivity shall not be acceptable.

b. All network cabling shall be Cat5e or Cat6 conforming to TIA-568A/B, and shall be installed and certified by a qualified network installer.

16. Provide

a. Ethernet Switches shall be Pathway Pathport® VIA 10-Port+1 Managed Ethernet Switch Model # 6730, or approved equal.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all lighting fixtures, equipment, and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing lighting fixtures.

B. Unless otherwise shown on the Contract Drawings, all lighting outlets shall have lighting fixtures. In instances where a specific lighting fixture has not been assigned to a lighting outlet, furnish and install a complete lighting fixture of the type and wattage designated for outlets of similar function and/or type as directed by the Engineer.

3.03 LIGHTING CONTROL SYSTEMS INTEGRATOR'S SERVICES

A. Upon completion of the installation, including testing of load circuits, the Contractor shall notify the LCSI's Project Manager that the system is available for formal checkout by the dimming system manufacturer.

B. Notification shall be provided in writing, 21 days prior to the time factory-trained personnel are needed on the job site.

C. No power is to be applied to the dimming system unless specifically authorized by written instructions from the LCSI's Project Manager.

D. The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.

E. Upon completion of the formal check-out after programming and scheduling initial 12 looks as dictated by the Port Authority into the control system calendar, the factory engineer shall demonstrate operation and maintenance of the system to the Authority's representatives. Training session shall not exceed four working hours.

F. A second training session shall be provided six months after the first training session. Training session shall not exceed four working hours. Additional training shall be available upon request. Scheduling for training sessions shall be made in writing, 21 days prior to the time factory-trained personnel are needed on the job site.

G. LCSI shall coordinate with provider of SCADA system to coordinate user interface and control signal requirements of each system to properly integrate lighting controls with SCADA system.

3.04 RECORD DRAWINGS AND MANUALS

A. Record Drawings

1. The LCSI shall submit two sets of full sized Record Drawings to the Authority for final acceptance. These drawings shall be fully revised and reflect the actual finished installation. The drawing set shall be 100% complete and shall include all schematics, details and Bill of Materials for future maintenance and repair of all systems supplied by the LCSI.

   a. Each drawing shall be dated and stamped as a Record Drawing.

   b. Prints shall be full sized, stapled into sets. They shall be fully legible.

c. Any future revisions or modifications during the warranty period shall require that the Authority's Record Drawings be updated also.

B. Manuals

1. Manuals shall be bound by the LCSI in loose-leaf binders and labeled with tabbed dividers for easy reference.

2. The LCSI shall provide two sets of Instructions and Maintenance manuals to the Authority. The manuals shall consist of, but not be limited to:

a. System Description

b. User Operating Instructions

c. User Maintenance Instructions

d. Catalogue Cut Sheets from all equipment purchased

e. Spare Parts Listing

f. 11" x 17" reduced drawings of all system assemble drawings needed to perform system maintenance.

3.05 INSTALLATION

A. Install all lighting equipment and accessories, as well as all lighting fixtures, in the locations shown on the Contract Drawings in accordance with the manufacturer's written instructions. All lighting fixtures shall be properly secured to structural elements.

B. Lighting fixtures shall be carefully supported and aligned with necessary brackets, and supporting members for proper installation, all as shown in the Contract Drawings and the Specifications, and as approved by the Engineer. No rivets, springs, or other hardware shall be visible after installation.

C. Lighting fixtures shall be supported to satisfy seismic requirements described in applicable local codes.

D. All lighting fixtures shall be properly wired and connected to branch circuits, tested, and left ready for programming and operation. Bond all lighting fixtures and metal accessories to the branch circuit-grounding conductor.

3.06 ADJUSTMENTS

A. Prior to final inspection, replace all fixtures which have failed and contact LCSI for readdressing, and leave all lighting fixtures, equipment, and accessories in good, uniform operating condition. The Contractor shall replace any failed fixtures during the first 100 days after the completion of the Contract.

B. Position and lock all lighting fixtures as shown on the Contract Drawings.

C. Cleaning

1. Clean all components of the lighting system to remove conductive and deleterious materials.

2. Remove dirt and debris from all fixtures and lenses.

3. Clean finishes and touch up damage.

END OF SECTION

SECTION 16512

COLOR CHANGING LIGHTING SYSTEM

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Requirements for Approval: Lighting Control Systems Integrators seeking acceptance must submit the following information along with the equipment submittal. Failure to submit any of the required information will automatically disqualify the Contractor from consideration of approval.

1. A listing of 3 equivalent installations including:

   a. Name, address, and current telephone number of Authority.

   b. Name, address, and current telephone number of Architect, Engineer or Lighting Consultant associated with the installation.

   c. Scope of work of the installation including relevant Sub-Contractors and manufacturers.

2. A brief written description of the LCSI's operation, including facilities, departments and key personnel.

3. Biographical information of the Project Manager and integration team members who will be assigned to this project should the Contractor be successful.

4. A full and complete financial statement sufficient to determine financial viability.

5. A list of all Sub-Contractors who the LCSI proposes to use including their qualifications to perform the work.

B. Manufacturer shall provide 5 sets of full system submittals. Submittals shall be 11"x17" and include:

1. Full system riser diagram(s) illustrating interconnection of system components, how the system attaches to building structure, and any special installation considerations.

2. Full set of printed technical data sheets.

3. Detailed set of drawings, including a complete list of all deviations from specifications.

C. Manufacturer shall provide any additional information, including equipment demonstration, as required by the Architect to verify compliance with specifications.

D. Shop Drawings

1. For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.

2. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format

   a. Luminaire, ballast and lamp description and manufacturer's complete catalog number

   b. Luminaire drawing with basic dimensions

   c. Candela Distribution Table and Curve

   d. Zonal Lumen Summary Table

   e. Luminance Summary Table

   f. Input Watts

   g. Luminaire Efficiency

3. For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.

4. For control system equipment: Submit shop and installation drawings and schedules showing all information necessary to explain fully the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. They shall be approved by the Lighting Consultant or Engineer before fabrication, installation, or erection has begun. Such approval does not relieve the LCSI of the responsibility of providing equipment in accordance with the specifications. Any deviations from the specifications shall be "starred" and noted in 3/8-inch high letters. Only deviations that are equal to, or that upgrade the quality of, the equipment, or that respond to field conditions, will be considered.

5. Lighting management system: Submit schematic wiring diagrams, component specifications, enclosure dimensions, installation details, operation manual, and approvals of respective standards.

6. Control system components: Submit schematic diagrams, component specifications, enclosure dimensions, installation details, and approvals of respective standards.

E. Catalog Cuts

1. The Contractor shall submit catalog cuts for equipment items. These shall contain full information on dimensions, construction, applications, etc. to permit proper evaluation. In addition, they shall be properly identified as to their intended use. Any options or variations shall be clearly noted.

F. Samples

1. The Lighting Control Systems Integrator shall submit samples without causing delay in work, as required.

2. For items indicated on the Contract Drawings submit working samples for review and approval upon request by the Engineer. Install and energize samples as shown on the Contract Drawings or as directed by the Engineer.

G. Mock-up

1. If requested on the Contract Drawings, provide mock-up installation for review and approval by the Engineer. The mock-up shall simulate specified lighting system conditions as shown on the Contract Drawings.

2. For each substitution item which is not specified on the Contract Drawings provide mock-up installation at no cost to the Authority if requested, and as directed by the Engineer.

H. Manuals

1. At time of hand over LCSI.shall provide Authority with five (5) sets of drawings describing the system installed and copies of the instruction manual to operate the customized interface.

I. Training

1. The LCSI shall coordinate and schedule up to three (3) days of training and programming for a maximum of eight (8) hours per day with the necessary operations and maintenance personnel. Training shall include instruction on running and maintaining the system including but not limited to how to schedule looks in the future, monitor system, override scheduled looks, maintain controls and data connections and review steps for expanding number of looks.

END OF APPENDIX "A"

DIVISION 16

SECTION 16514

LIGHTING SYSTEMS MODIFIED

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for Lighting Systems. Related Work specified in other Sections of the Specifications includes the following: 16512 COLOR CHANGING LIGHTING SYSTEM.

1.02 REFERENCES

The following is a listing of the publications, standard and codes referenced in this Section, of which the latest edition shall govern:

American National Standards Institute (ANSI)

ANSI C 78.379	Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps – Classification of Beam Patterns
ANSI C 82.4	Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps

Illuminating Engineering Society of North America (IESNA)

National Equipment Manufacturers Association (NEMA)

NEMA WD6	Wiring Devices - Dimensional Requirements

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 101	Life Safety Code

Administrative Code

NYCEC	Electrical Code of the City of New York
NYCECC	New York City Energy Conservation Code

Underwriters Laboratories (UL)

UL57	Electric Lighting Fixtures
UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1572	High Intensity Discharge Lighting Fixtures

OSHA Occupation Safety and Health Administration

The Energy Policy Act of 1992

Lamp Efficiency Labeling and Standards

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Lighting System shall be furnished, supplied, installed and adjusted in accordance with *this Section and as specified on the Contract Documents*

B. Components of the Lighting System manufactured, supplied and installed shall comply with the requirements of NFPA 70, NFPA 101, all local codes and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. Entities manufacturing lighting fixtures, equipment, and components specified herein, and as shown on the Contract Drawings, shall have a minimum of five years of manufacturing experience and shall demonstrate prior experience on at least two projects involving complexities similar to those required under this Contract.

B. Lighting Equipment for which there is a nationally recognized standard shall be safety tested and bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc. (UL, ETL, Factory Mutual or approved equal, certifying that the lighting fixtures and equipment are listed as suitable for the purpose specified and shown on the Contract Drawings.

C. Lighting equipment shall be manufactured and installed in compliance with applicable articles of NFPA 70, NFPA 101 and NYCEC.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, disposed of, and replaced with dry wrapping materials to prevent staining finish.

B. Deliver materials in manufacturer's original, unopened, protective packaging.

C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.

D. Handle in a manner to prevent damage to finished surfaces.

E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

1.06 SPARE PARTS

A. Unless otherwise noted on the Contract Document, provide 10% (or minimum of 4) replacement lamps for each type of lamp installed.

B. Unless otherwise noted on the Contract Document, provide 5% (or minimum of 2) replacement ballasts for each type of ballast installed.

1.07 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. General

All components of the lighting system shall be manufactured by the companies shown on the Contract Drawings

2.02 MATERIALS

A. General

The location, number, size, and type of all lighting fixtures and accessories to be installed shall be as shown on the Contract Drawings.

B. Lighting Fixtures

Lighting fixtures shall be furnished with lamps, which comply with the requirements of this Section, and as shown on the Contract Drawings. All fluorescent and high intensity discharge lighting fixtures supplied shall come with factory installed ballasts, which comply with the requirements of this Section, and as specified on the Contract Drawings.

Unless otherwise shown on the Contract Drawings lighting fixtures shall comply with the following requirements:

1. Housing
   a. Lighting fixtures shall be of rigid construction and built in accordance with NEMA WD6.
   b. Ferrous components shall be protected from corrosion by plating or finished with white baked enamel unless another color is shown on the Contract Drawings. All paint shall be spray-applied and baked at 350°F, for at least 20 minutes. Interior surfaces of all fluorescent fixtures shall be white enamel of minimum 87% reflectance.
   c. Exposed parts of the lighting fixture housing shall be free from spinning lines, ripples, or other visible marks and manufacturer's stickers.
   d. Outdoor lighting fixture housings shall be constructed of copper-free cast aluminum (copper content less than 0.4%, Alloy 360.4) or stainless steel. Housings shall be properly gasketed to be watertight. All hardware shall be stainless steel.
   e. Ballast compartment shall be so designed that ballast temperature shall not exceed the UL limit of 105°C at 40°C ambient temperature.
2. Optical System
   a. Reflectors

(1) HID Optical systems shall be a homogenous sheet and extruded aluminum, electrochemically brightened, anodized and sealed.

(2) Diffuser reflectors shall be finished with high-reflectance, baked white enamel with a non-yellowing binder.

(3) The visible clear Alzak reflectors shall be of non-iridescent finish with a minimum reflectance of 90%.

b. Lenses, Diffusers, and Shielding Devices

(1) Lenses, diffusers, and shielding devices shall be properly and securely mounted within the lighting fixture housing. Lay-in lenses, diffusers, or shielding devices shall not be acceptable.

(2) Glass lenses or diffusers shall be constructed of tempered, borosilicate glass.

(3) Plastic lenses or diffusers shall be white opal or clear, prismatic, 100% ultraviolet-stabilized acrylic or high-impact polycarbonate. Plastic lenses shall be installed with the smooth side out.

(4) The shielding and optical materials shall be tightly fitted with no loose parts and shall show no visible leaks of unintentional light.

C. Lamps

1. *General*

Lamps shall comply with the requirements of the Energy Policy Act of 1992 or its latest editions.

2. High Intensity Discharge Lamps

Unless otherwise shown on the Contract Documents, lamps shall comply with the following requirements:

a. Ceramic Metal Halide (CMH) Lamps

(1) CMH lamp fixtures shall be connected only to circuits that are turned off for at least 15 minutes a day. Use of CMH lamps in uninterrupted 24-hour operation circuits is not permitted.

(2) Minimum average lamp life at 10 hours per start shall be 24,000 hours

(3) Minimum efficacy: 90 lm/W

(4) CCT 4200°K

(5) Maximum lamp lumen depreciation at the end of rated life: 30%

(6) Maximum color shift ±250 degrees Kelvin

(7) Minimum Color Rendering Index (CRI): 90

D. Ballasts

1. High Intensity Discharge (HID) Ballasts

a. HID lamp ballasts shall comply with ANSI C 82.4, and shall be the high-power factor, constant wattage auto-transformer (CWA), or similar, type of automatic wattage regulation.

b. The power loss of HID lamp ballasts, as a percentage of lamp wattage, shall not exceed 20%.

c. HID lamp ballasts for indoor applications in public spaces shall be encased and potted for the purpose of noise reduction.

d. HID lamp ballasts shall be wired and grounded in accordance with NFPA 70 and the manufacturer's written instructions.

e. Remote HID lamp ballasts shall be installed in accordance the manufacturer's written instructions.

f. Unless otherwise noted on the Contract Drawings all HID ballasts, which are not used in 24 hours operations, shall be furnished with automatic protective starters. An automatic protective starter shall apply pulses for no more than 15 minutes and then deactivate if a lamp arc cannot be initiated.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all lighting fixtures, equipment, and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing lighting fixtures.

B. Unless otherwise shown on the Contract Drawings, all lighting outlets shall have lighting fixtures. In instances where a specific lighting fixture has not been assigned to a lighting outlet, furnish and install a complete lighting fixture of the type and wattage designated for outlets of similar function and/or type as directed by the Engineer.

3.03 INSTALLATION

A. Install all lighting equipment and accessories, as well as all lighting fixtures, complete with lamps, in the locations shown on the Contract Drawings in accordance with the manufacturer's written instructions. All lighting fixtures shall be properly secured to structural elements.

B. Lighting fixtures shall be carefully supported and aligned with necessary hangers, supporting members, and plaster frames for proper installation, all as shown in the Contract Drawings and the Specifications, and as approved by the Engineer. No rivets, springs, or other hardware shall be visible after installation.

C. Lighting fixtures shall be supported to satisfy seismic requirements described in applicable local codes.

D. All lighting fixtures shall be properly wired and connected to branch circuits, tested, and left ready for operation. Bond all lighting fixtures and metal accessories to the branch circuit-grounding conductor.

3.04 ADJUSTMENTS

A. Prior to final inspection, relamp all fixtures which have failed lamps, or lamps where visible color shift has occurred, and leave all lighting fixtures, equipment, and accessories in good, uniform operating condition. The Contractor shall replace any burned-out lamp during the first 100 days after the completion of the Contract.

B. Aim, adjust and lock all lighting fixtures as shown on the Contract Drawings. Once rough aimed contact the Lighting Consultant to review the fixture aiming at night once aiming areas are clear of construction equipment.

C. Cleaning

1. Clean all components of the lighting system to remove conductive and deleterious materials.
2. Remove dirt and debris from all enclosures.
3. Clean finishes and touch up damage.

END OF SECTION

SECTION 16514 MODIFIED

LIGHTING SYSTEMS MODIFIED

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.
2. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format
   a. Luminaire, ballast and lamp description and manufacturer's complete catalog number
   b. Luminaire drawing with basic dimensions
   c. Candela Distribution Table and Curve
   d. Coefficient of Utilization Table
   e. Visual Comfort Probability Table
   f. Zonal Lumen Summary Table
   g. Luminance Summary Table
   h. Input Watts
   i. Luminaire Efficiency
3. For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.
4. For each ballast type: Submit manufacturer's data with ballast description, catalog number, lamp type, input voltage, in-rush current, line current, input wattage, ballast factor, power factor, crest factor, minimum starting temperature, total harmonic distortion and wiring diagram.
5. Lighting management system: Submit schematic wiring diagrams, component specifications, enclosure dimensions, installation details, operation manual, and approvals of respective standards.
6. Dimmer system components: Submit schematic diagrams, component specifications, enclosure dimensions, installation details, and approvals of respective standards.
7. Photoelectric Control Devices: Submit manufacturer's data for ambient light sensors, timers, infrared and ultrasonic occupancy sensors.

B. Samples

For items indicated on the Contract Drawings submit working samples for review and approval upon request by the Engineer. Install and energize samples as shown on the Contract Drawings or as directed by the Engineer.

C. Mock-up

1. If requested on the Contract Drawings, provide mock-up installation for review and approval by the Engineer. The mock-up shall simulate specified lighting system conditions as shown on the Contract Drawings.

2. For each substitution item which is not specified on the Contract Drawings provide mock-up installation at no cost to the Authority if requested, and as directed by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16550

ROADWAY LIGHTING

PART 1. GENERAL

1.01 SUMMARY

A. Architectural LED Roadway Lighting.

B. Lighting Poles.

1.02 RELATED SECTIONS

A. Division 16 - (which sections?)

1.03 REFERENCES

A. Ameican National Standards Institute (ANSI)

1. C62.41.2-2002- IEEE Recommended Practice on Surge Voltages in Low-Voltage (1000V or less) AC Power Circuits.
2. C78.377-2008- Standard for Chromaticity of Solid-State Lighting Products
3. C82, SSL1- SSL Drivers (in ANSI development.
4. C136.23-2006- Roadway and Area Lighting Equipment Enclosed Architectural Luminaires
5. C136.31-2001- Standard for Roadway Lighting Equipment – Luminaire Vibration.

B. American Society of Testing and Materials (ASTM)

1. ASTM B117-97- Salt Spray (Fog) Testing.
2. ASTM G53- Exposure of non-metallic materials to UV radiation

C. Design Lights Consortium (DLC).

D. Illuminating Engineering Society of North America.

1. RP-8-2005- Recommended Practice for Roadway Lighting.
2. LM-79-08- Approved Methind for Electrical and Photometric Measurement of Solid State Lighting Products.
3. LM-80-08- Approved Method for Measuring Lumen Maintenance of LED Light Sources.
4. TM-15-11- Luminaire Classification System

E. International Electrotechnical Commission (IEC)

1. 60529, CORR3- Degrees of Protection provided by enclosures (IP Code)

F. Joint Electron Devices Engineering Council (JEDEC).

G. Underwriter's Laboratory, Inc.- Standards of Safety for Electrical Equipment (UL).

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer that has been manufacturing area and roadway light fixtures for a period of at least ten years.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Philips Gardco , which is located at: 1611 Clovis Barker Rd. ; San Marcos, TX 78666; Toll Free Tel: 800-227-0758; Tel: 512-753-1000; Email: request info (amy.taylor-mendez@philips.com); Web: www.sitelighting.com.

B. Substitutions: Not permitted.

2.02 ARCHITECTURAL LED ROADWAY LUMINAIRE (ALRL) AND LED PEDESTRIAN LUMINARE (ALPL)

A. Pole-mounted architectural LED roadway luminaire (ALRL) shall be a product that in appearance shall not be confused with a conventional roadway (cobrahead) or the solid-state source products intended to replace such. The design character of the product should stand on its own adding to the character of the structure while not standing out (sentence seems not complete)

1. ALRL luminaries:

a. Model: Phillips Gardco Pure Form P32

(1) Model P32-A3: The body of the luminaire shall be die-cast aluminum and have a maximum overall depth of 3.0 inches a width of 20.3 inches, and an overall projection of 48.74 inches. EPA fpr this configuration shall not exceed 0.55 ft^2.

b. Body/Housing: The body of the luminaire shall flow from nose to pole with no visible seam from below. It shall arrive to work-site as a one-piece product requiring no additional accessories to mount the luminaire to the pole. The luminaire shall be vibration tested in accordance with ANSI C136.31 by an independent laboratory and meet a 3G rating, suitable for use on bridge and overpass applications.

c. Thermal management: The luminaire shall be vented on three sides to allow for free airflow across the thermal dissipation device (passive only). The actual thermal dissipation device shall be designed and manufactured in such a way to utilize this free airflow to aggressively dissipate any heat produced by the light engine. It may be open on top but should have some means to block direct view of the device such as a screen painted to match the color of the luminaire. Manufacturer shall make available a bird deterrent kit to keep sea gulls and other large birds from perching and/or roosting on top of the thermal dissipation device component.

d. Light engine: Optical components making up the light engine shall be physically separate from the electrical compartment and inaccessible without first accessing the electrical compartment.

(1) The primary component of the light engine shall be an MCPCB with 48, 64, or 80 LEDs per board.

(2) Each individual LED shall be shunted such that in the event of a device failure, it shall not affect the performance of other LEDs on the board.

(3) The board shall have a quick-disconnect between the board and the driver to allow for simplified maintenance in the event replacement is required

(4) The optical lens shall be 0.188 inch (4.76 mm) thick injection molded clear non-yellowing DR acrylic. It shall fasten directly through the board to the thermal dissipation device in a sandwich compression method. This optical assembly shall be independently certified by a third-party laboratory for ingress protection. It shall be IP66 at a minimum..

(5) The optics shall be designed and manufactured in such a way that no more than 10% of the total candela produced by the light engine is emitted about 80-degrees above nadir thereby limiting the potential for unnecessary glare.

(6) The optics shall include a black matte over the optic to limit aperture brightness. The black matte shall include a punch out for the individual optic bubble and a micro-mirror, re-directing reflector to limit wasted light and energy from escaping behind the pole.

e. Electrical:

(1) The electrical compartment shall be IP66 certified by an independent laboratory.

(2) The LED driver(s) shall be tray-mounted

(3) The driver tray shall be removable without the use of any tools.

(4) The LED driver(s) shall have a quick-disconnect on the lead to the LED array. Wire nuts or crimps are not acceptable.

(5) The LED driver shall be manufactured by the same company that manufactures the luminaire.

f. Power:

(1) Average system wattage per unit shall not exceed 140 watts.

(2) Primary system voltage shall be 277 volts.

g. Optical System Distribution: The luminaire manufacturer shall offer a complete set of optical distributions for their product.

h. Performance. (what is the performance requirement?)

i. Finish: The finishing of the luminaire shall be a marine grade finish, incorporating three separate and distinct coatings as well as the appropriate cleaning and rinsing of all metal parts to be painted. The three coatings shall include an undercoat or primer after all metal surfaces have been sufficiently cleaned and rinsed. After the primer coat, the actual paint finish shall be applied and cured. Once the paint finish has cured, a third and final finish sealer shall be applied and cured. The actual painted finish shall be a fade and abrasion resistant electrostatically applied, thermally cured, (TGIC) polyester powder coat finish.

1. Finish for luminaires, is by Philips Gardco, Natural Aluminum paint.

j. Labels:

(1) Luminaries bear UL wet location label.

(2) All luminaires shall bear a manufacturer's label, identifying the manufacturer, their catalog number, luminaire wattage, and date of manufacture

k. Warranty:

(1) Manufacturer shall provide a written warranty of a minimum of five full years. This warranty shall cover the light arrays, drivers, all wiring and hardware, as well as the integrity of the finish.

(2) Manufacturer shall be required to demonstrate capability to cover a catastrophic failure of product on this project. This shall include the need to replace product with that of another manufacturer and the labor to accommodate the change.

B. Pole-mounted architectural LED pedestrian luminaire (ALPL) shall be a product that in appearance shall not be confused with a conventional ped-pole product (shoebox) or the solid-state source products intended to replace such.

1. ALPL luminaries:

a. Model: Phillips Gardco PureForm P21.

(1) Model P21-A1: The body of the luminaire shall be die-cast aluminum and have a maximum over depth of 3.0 inches , a width of 20.3 inches , and an overall projection of 30.04 inches. EPA for this configuration shall not exceed 0.35 ft^2.

b. Body/housing: The form of the housing shall flow from nose to pole with no visible seam from below. The product shall arrive to the work-site as a one-piece product requiring no additional accessories to mount the luminaire to the pole. The luminaire shall be vibration tested in accordance with ANSI C136.31 by an independent laboratory and meet a 3G rating, suitable for use on bridge and underpass applications.

c. Thermal management: The luminaire shall be vented on three sides to allow for free airflow across the thermal dissipation device (passive only). The actual thermal dissipation device shall be designed and manufactured in such a way to utilize this free airflow to aggressively dissipate any heat produced by the light engine. It may be open on top but should have some means to block direct view of the device such as a screen painted to match the color of the luminaire. Manufacturer shall make available a bird deterrent kit to keep sea gulls and other large birds from perching and/or roosting on top of the thermal dissipation device component.

d. Light engine: Optical components making up the light engine shall be physically separate from the electrical compartment and inaccessible without first accessing the electrical compartment.

(1) The primary component of the light engine shall be an MCPCB with 48, 64, or 80 LEDs per board.

(2) Each individual LED shall be shunted such that in the event of a device failure, it shall not affect the performance of other LEDs on the board.

(3) The board shall have a quick-disconnect between the board and the driver to allow for simplified maintenance in the event replacement is required.

(4) The optical lens shall be 0.188 inch (4.76 mm) thick injection molded clear non-yellowing DR acrylic. It shall fasten directly through the board to the thermal dissipation device in a sandwich compression method. This optical assembly shall be independently certified by a third-party laboratory for ingress protection. It shall be IP66 at a minimum.

(5) The optics shall be designed and manufactured in such a way that no more than 10% of the total candela produced by the light engine is emitted about 80-degrees above nadir thereby limiting the potential for unnecessary glare.

(6) The optics shall include a black matte over the optic to limit aperture brightness. The black matte shall include a punch out for the individual optic bubble and a micro-mirror, re-directing reflector to limit wasted light and energy from escaping behind the pole.

e. Electrical:

(1) The electrical compartment shall be IP66 certified by an independent testing laboratory.

(2) The LED driver(s) shall be tray-mounted for simplified maintenance.

(3) The driver tray shall be removable without the use of any tools.

(4) The LED driver(s) shall have a quick-disconnect on the lead wires to the LED array. Wire nuts or crimp connectors are not acceptable.

(5) The LED driver shall be manufactured by the same company that manufactures the luminaire.

f. Power:

(1) Wattage consumed per unit shall not exceed 70 watts.

(2) Primary voltage shall be 277 volts.

g. Optical System Distribution: The luminaire manufacturer shall offer a comprehensive set of optical distributions for their product.

(1) The optics provided shall be either IES Type II or Type II as called out per plans.

h. Performance: (what is the performance requirement?)

i. Finish: The finishing of the luminaire shall be a marine grade finish, incorporating three separate and distinct coatings as well as the appropriate cleaning and rinsing of all metal parts to be painted. The three coatings shall include an undercoat or primer after all metal surfaces have been sufficiently cleaned and rinsed. After the primer coat, the actual paint finish shall be applied and cured. Once the paint finish has cured, a third and final finish sealer shall be applied and cured. The actual painted finish shall be a fade and abrasion resistant electrostatically applied, thermally cured, (TGIC) polyester powder coat finish.

(1) Finish for poles, is by Valmont Industries, 'Natural Aluminum' polyester powder.

j. Labels: Luminaries bear UL or CUL, as applicable wet location labels.

2.03 OUTDOOR PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal by one of the following:

1. Intermatic, Inc.
2. Cooper Industries, Inc.

3. NSi Tork

B. Description: Solid state, with SPST, Intermatic #K4253 rated for 3100-4150 watts tungsten, 8.3 amps, to operate connected relay, contactor coils, complying with UL 773A.

1. Listed and labeled as defined in NYC Construction Code, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, light level slide adjustment
3. Time delay action eliminates load switching off due to car head lights & lighting.
4. Time Delay: Fifteen second minimum, to prevent false operation.
5. Surge Protection: Metal-oxide varistor.
6. Mounting: Swivel Mount with NEMA C136.10, as required to direct sensor to the north sky exposure.

2.04 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Allen-Bradley Series 500, 20 amp, multi-pole lighting contactor, #500LG-4-0-A3-E. or approved equal by one of the following:

1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
2. Eaton Corporation.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
4. Square D; a brand of Schneider Electric.

B. Automated System (SCADA) Interface: Provide hardware interface to enable the scada to monitor and control lighting contactors. Data system is covered in Section 16936 "Supervisory Control and Data Acquisition (SCADA) System."

1. Monitoring: On-off status.
2. Control: On-off operation.

PART 3. EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation..

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.04 Protection

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 16550

ROADWAY LIGHTING

APPENDIX A

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS:

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods
4. Actual working sample.

B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

C. Verification Samples: For each finish product specified, two samples, minimum size 4 inches (100 mm) square, representing actual product, color, and patterns.

D. Manufacturer's Certificates: Independent certification is required to ensure products meet or exceed specified requirements.

E. Shop Drawings

1. For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.

2. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format.

   a. Luminair, ballast and lamp description and manufacturer's complete catalog number.
   b. Luminaire drawing with basic dimensions.
   c. Candela Distribution Table and Curve.
   d. Coefficient of Utilization Table.
   e. Visual Comfort Probability Table.
   f. Zonal Lumen Summary Table.
   g. Luminance Summary Table.
   h. Input Watts.
   i. Luminair Efficiency.

3. For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.

4. For each ballast type: Submit manufacturer's data with ballast description, catalog number, lamp type, input voltage, in-rush current, line current, input wattage, ballast factor, power factor, crest factor, minimum starting temperature, total harmonic distortion and wiring diagram.

5. Lighting management system: Submit schematic wiring diagrams, components specifications, enclosure dimensions, installation details, operation manual, and approvals of respective standards.

6. Dimmer system components: Submit schematic diagrams, components specifications, enclosure dimensions, installation details, and approvals of respective standards.

7. Photoelectric Control Devices: Submit manufacturer's data for ambient light sensors, timers, infrared and ultrasonic occupancy sensors.

B. Mock-up

1. If requested on the Contract Drawings, provide mock-up installation for review and approval by the Engineer. The mock-up shall simulate specified lighting system conditions as shown on the Contract Drawings.

2. For Each substitution item which is not specified on the Contract Drawings provide mock-up installation at no cost to the Authority if requested, and as directed by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16611

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1. GENERAL

1.01 SUMMARY

A. This Section includes 3-phase, on-line, solid state-type, uninterruptible power supply (UPS) systems, complete with battery, battery circuit breaker and maintenance by-pass switch.

1.02 REFERENCES

A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this Specification shall govern.

- ANSI C62.41 (IEEE 587)
- ASME
- FCC Part 15, Sub Part J, Class A
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

B. NFPA 70 (NEC 2008).

C. Electronic Industries Association (EIA):

- EIA 310, "Racks, Panels, and Associated Equipment" (copyrighted by EIA, ANSI approved).

D. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

- ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI approved).

E. International Organization for Standardization (ISO):

- ISO 9001, "Quality Management Systems - Requirements."
- ISO 14001, "Environmental Management Systems - Requirements With Guidance for Use."

F. Underwriters Laboratories, Inc. (UL):

- UL 891, "Standard for Dead-Front Switchboards" (copyrighted by UL, ANSI approved).
- UL 1778, "Standard for Uninterruptible Power Supply Equipment" (copyrighted by UL, ANSI approved).
- UL 60950, "Standard for Information Technology Equipment."

1.03 DEFINITIONS

A. UPS: Uninterruptible power supplies that automatically provide power, without delay or transients, during any period when the normal power supply is incapable of performing acceptably.

B. THD: Total harmonic distortion.

1.04 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Authority of other rights the Authority may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: A written warranty, acceptable to the Authority in form and substance, signed by manufacturer and principal installer, agreeing to replace UPS system storage batteries that fail in materials or workmanship within the specified warranty period.

1. Special Warranty Period for Batteries in Mechanical Electrical Buildings: Twenty (20) years from date of issuance of Certificate of Final Completion.

C. UPS Module

1. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for thirty six (36) months after initial start-up or forty two (42) months after ship date, whichever period expires last.

D. Battery

1. The battery manufacturer's standard warranty shall be submitted to the Authority.

1.05 QUALITY ASSURANCE

Manufacturer Qualifications

A. A minimum of five (5) year's experience in the design, manufacture, and testing of solid-state UPS systems is required.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or a full member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

C. Comply with NFPA 70.

D. Comply with NFPA 75. Mark UPS components as suitable for installation in computer rooms

E. Source Limitations: Obtain UPS, including components, from a single manufacturer with responsibility for entire system.

F. Listing and Labeling: Provide UPS specified in this Section that are listed and labeled as a factory-assembled unit.

G. Listing and Labeling: Provide UPS specified in this Section that are listed and labeled for use in computer rooms.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

H. *Comply with UL 1778 – Listed and labled.*

I. Factory Testing

1. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification. These tests shall include operational discharge and recharge tests on at least a one-minute battery plant to assure guaranteed rated performance.

1.06 SUBMITTALS

A. See Appendix "A" for submittal requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.

B. Store equipment in spaces with environments that are controlled within manufacturer's ambient temperature and humidity tolerances for non-operating equipment.

1.08 SYSTEM DESCRIPTION

A. Design Requirements - UPS Module

1. Voltage: Input/output voltage specifications of the UPS shall be:

   Input: 208 volts, three-phase, 4-wire-plus-ground.

   a. Output: 120/208 volts, three-phase, 4-wire-plus-ground.

2. Output Load Capacity. Specified output load capacity of the UPS shall be as shown on the Contract Documents at 0.8 lagging power factor.
3. The input current total harmonics content (CTHDS) shall not exceed ten percent (10%).
4. The output current total harmonics content shall not exceed five percent (5%).

B. Design Requirements - Battery Cabinet

1. Battery Cells: Sealed, lead-acid, valve-regulated.
2. Reserve Time: Two hundred and forty (240) minutes at 50% load, 0.8 power factor, with ambient temperature between 20 and 30 degC.
3. Recharge Time: to ninety-five percent (95%) capacity within ten (10) times discharge time.

C. Design Requirements - Internal static by-pass transfer switch.

1. Provide an internal Static By-pass transfer switch.

D. Design Requirements - External maintenance by-pass switch.

1. Provide an external maintenance by-pass switch, isolation switches and input/output protective circuit breakers. The switch shall be rated for full load current.

E. Modes of Operation

The UPS shall be designed to operate as an on-line reverse transfer system in the following modes:

1. Normal - The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.
2. Emergency - Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation
3. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
4. Recharge - Upon restoration of the AC input source, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.
5. Bypass - The static bypass shall be used to provide transfer of critical load from the inverter output to the bypass source. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
6. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.

7. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
8. Bypass - The external make-before-break maintenance bypass cabinet (MBC) to electrically isolate the UPS during routine maintenance and service of the UPS. The MBC shall completely isolate both the UPS input and output connections.
9. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions in subparagraphs below without interrupting supply to the load during switching:

    a. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
    b. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
    c. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.

10. Manual operation includes the following:

    a. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
    b. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

F. Performance Requirements

1. AC Input to UPS

    a. Voltage Configuration for Standard Units: three-phase, 4-wire plus ground.
    b. Voltage Range: +/- 15% of nominal.
    c. Frequency: Nominal frequency +/- 12%.
    d. Power Factor: 0.99 lagging minimum at nominal input voltage and full rated UPS output load.
    e. Inrush current: 150% of full load current maximum.
    f. Short Circuit Withstand Rating: 30,000 symmetrical amperes.
    g. Maximum Frequency Range: 40 hertz to 70 hertz.
    h. Current Distortion: 6% THD maximum at full load.
    i. Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41-1980.

2. AC Output, UPS Inverter

    a. Voltage Configuration: three-phase, 4-wire plus ground

b. Voltage Regulation: +/- 1% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

+/- 2% three-phase RMS average for a 50% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

c. Frequency: Nominal frequency +/- 0.1%.

d. Phase Displacement:

+/- 1 degree for balanced load.
+/- 1 degrees for 50% unbalanced load.

e. Bypass Line Sync Range: +/- 0.5 Hertz. Field selectable +/- 0.5, 1.0, 3.0, 5.0 Hz.

f. Voltage Distortion: 5% total harmonic distortion (THD) for linear loads. 3% maximum for any single harmonic.

g. Load Power Factor Range: 0.9 leading to 0.5 lagging.

h. Output Power Rating: Rated kVA at 0.8 lagging power factor.

i. Overload Capability:

300% for short circuit clearing
105% for 10 minutes (without bypass source).
150% for 30 seconds (without bypass source).

j. Inverter Output Voltage Adjustment: +/- 5% manual adjustment.

k. Voltage Transient Response:

100% load step	+/- 5%
loss or return of AC input power	+/- 1%
manual transfer of 100% load	+/- 1%.

l. Transient Recovery Time: to within 1% of output voltage within 60 milliseconds.

3. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

1.09 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

UPS Module: 32 degF to 104 degF.
Battery: 77 +/- 9 degF (25 +/- 5 degC).

B. Storage/Transport Ambient Temperature

-4 degF to 158 degF (-20 degC to 70 degC).

C. Relative Humidity

0 to 95%, non-condensing.

D. Altitude Operating: to 6600 ft. (2 000 meters) above Mean Sea Level. Derated for higher altitude applications.

Storage/Transport: to 40,000 ft. (12 200 meters) above Mean Sea Level.

E. Audible Noise

Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA measured 1 meter from surface of the UPS.

F. Seismic Performance: UPS shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

a. The term "withstand" means "the unit shall remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit shall be fully operational.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. APC by Schneider Electric
2. Liebert Corp.
3. Computer Power, Inc.
4. International Power Machines Corp.

2.02 COMPATIBILITY WITH LOAD

A. Operate within specified performance tolerances, supply type of distribution system indicated; and serve rated load comprised of various load elements. Load elements provide an overall load profile with the following characteristics:

1. Aggregate Load for Single-Phase Electronic Equipment with Switch-Mode Power Supplies, Served at 120 or 208 V: 55 percent of UPS capacity.

2.03 SYSTEM COMPONENTS, GENERAL

A. Description: Solid-state devices using hermetically sealed semiconductor elements. Devices include rectifier/battery charger, inverter, static bypass transfer switch, and system controls.

2.04 FABRICATION

A. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

2. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

B. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked with a visual indicator.

2. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

C. Construction and Mounting

1. The UPS unit, comprised of input isolation transformer, rectifier/charger with input filter, inverter, static transfer switch, and maintenance bypass switch, shall be housed in a single free-standing NEMA 250 type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and leveling feet shall be provided for ease of installation. Front access only shall be required for expedient servicing, adjustments, and installation. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

2. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug-in. Like assemblies and like components shall be interchangeable.

D. Cooling

1. Cooling of the UPS shall be by forced-air. Redundant fans shall be used. Low velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output.

2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

E. Grounding

1. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.05 COMPONENTS

A. Input Power Converters: The input power converters of the system shall be housed within the parallel connected, removable power modules, and shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and main inverter regulated output power.

1. Input Current Total Harmonic Distortion: The input current THDI shall be held to 6 percent or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.
2. Soft Start Operation: As a standard feature, the UPS shall contain soft start functionality, capable of limiting the input current from 0 percent to 100 percent of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation (di/dt = constant).
3. Magnetization Inrush Current: The UPS shall exhibit 0 inrush current as a standard product. Input Current Limit: The input converter shall control and limit the input current draw from utility to 150 percent of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100 percent load, charge batteries at 10 percent of the UPS output rating, and provide voltage regulation with mains deviation of up to ±15 percent of the nominal input voltage.
   a. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100 percent of UPS capacity, input current shall not exceed 126 percent of UPS output current, while providing full battery recharge power and importing necessary power for system losses.
4. Redundancy: The UPS shall be configured with redundant input converters, each with semiconductor fusing, and logic-controlled contactors to remove a failed module from the input bus.
5. Charging:
   a. The battery charging shall keep the DC bus float voltage of ±220 volts, ±1 percent.
   b. The battery charging circuit shall contain a temperature compensation circuit, which shall regulate the battery charging to optimize battery life.
   c. The battery charging circuit shall remain active when in static bypass and in normal operation.
6. Back-Feed Protection: The above mentioned logic-controlled contactor shall also provide the back-feed protection required by UL 1778.

B. Output Inverter: The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave delivered by the output inverters.

1. Overload Capability: The output power converters shall be capable of 300 percent for short circuit clearing. Steady state overload conditions, of up to 150 percent of system capacity shall be sustained by the inverter for 30 seconds in normal and battery operation. Should overloads persist past the outlined time limitation the critical load shall be switched to the automatic static bypass output of the UPS.
2. Output Contactor: The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus.
3. Battery Protection: The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.
4. Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window to optimize compatibility with local generator-set power source.
5. Redundancy: The UPS shall be configured with redundant output inverters, each with semiconductor fusing, and logic-controlled contactors to remove a failed component from the input, DC, and output critical bus.

C. Static By-Pass Transfer Switch: As part of the UPS, a system static bypass cabinet shall be provided. The system static bypass shall provide no break transfer of the critical load from the inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.

1. The design of the static switch power path shall consist of silicon-controlled rectifiers (SCR) with a continuous duty rating of 125 percent of the UPS output rating.
2. Automatic Transfers: An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical output bus of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.
3. Manual Transfers: Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.
4. Overloads: The static bypass shall be rated and capable of handling overloads equal to or less than 125 percent of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the static bypass shall be capable of sustaining overloads of 1000 percent of system capacity for periods of up to 500 milliseconds.
5. Modular: The static bypass switch shall be of a modular design.
6. Continuous duty at rated full load. Switch provides make-before-break transfer. A contactor or electrically operated circuit breaker in the inverter output provides electrical isolation.
7. System Protection: As a requirement of UL 1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring.

D. Maintenance Bypass Switch: A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power source, bypassing the rectifier/charger, inverter, and static transfer switch.

1. Isolation: All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operation.
2. Switch Rating: Continuous duty at rated full load of system.
3. Mounting Provisions: Locate inside one of the modular system cabinets, behind a lockable door.
4. Key interlock requires unlocking maintenance bypass/isolation switch before switching from normal position with key that is released only when UPS are bypassed by static bypass transfer switch. Lock is designed specifically for electrical component interlocking.
5. Maintenance Capability: With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static transfer switch.

E. Display and Controls

1. Monitoring and Control

The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A system power flow diagram shall be provided as part of the monitoring and controls sections which depict a single-line diagram of the UPS. Illuminated visual indicators shall be of the long-life light-emitting diode (LED) type. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on an alphanumeric LCD display. Additional features of the monitoring system shall include:

- Menu-driven display.
- Real time clock (time and date)
- Alarm history with time and date stamp
- Battery back-up memory.

2. Metering

The following parameters shall be displayed:

- Input AC voltage line-to-line and line-to-neutral for each phase
- Input AC current for each phase
- Input frequency
- Battery voltage
- Battery charge/discharge current
- Output AC voltage line-to-line and line-to-neutral for each phase
- Output AC current for each phase
- Output frequency
- Percent of rated load being supplied by the UPS
- Battery time left during battery operation.

3. Alarm Messages

The following alarm messages shall be displayed:

- Input power out of tolerance
- Input phase rotation incorrect
- Incorrect input frequency
- Charger in reduced current mode
- Battery Charger Problem
- Battery failed test
- Low battery warning (adjustable 1 to 99 minutes)
- Low battery shutdown
- DC bus overvoltage
- Bypass frequency out of range
- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to input power
- Input power single phased
- Input voltage sensor failed
- Inverter leg over current in X-phase
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Overload shutdown
- Control Error
- Critical power supply failure
- Load transferred due to internal protection
- External shutdown (remote EPO activated)
- Fan failure
- Overtemperature shutdown pending
- Overtemperature shutdown.

An audible alarm shall be provided and activated by any of the above alarm conditions.

4. Status Messages

The following UPS status messages shall be displayed:

- Normal operation
- Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery.

5. Free (Dry) Contacts: The following potential free contacts shall be available on the relay interface board:

- Normal operation.
- Battery operation.
- Bypass operation.
- Common fault.
- Low battery.
- UPS off.

6. Controls

UPS start-up, shutdown, and maintenance bypass operations shall be accomplished by a single rotary control switch. An advisory display and menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms.

7. Power Status Diagram

A mimic panel shall be provided to depict a single line diagram of the UPS. Indicating lights shall be integrated within the single line diagram to illustrate the status of the UPS. Two LEDs located on the diagram shall indicate whether UPS input and/or output power is present. The diagram shall be color coded with the positions of the rotary control switch for visual confirmation of the UPS operating mode.

8. On-Line Battery Test

The UPS shall be provided with a menu driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode. If the battery fails the test, the system shall automatically do the following:

a. transfer the load to bypass
b. restart the rectifier/charger
c. display a warning message
d. sound an audible alarm
e. retransfer the load back to normal mode.

The battery test feature shall have the following user selectable options:

a. DC bus voltage threshold (pass/fail value)
b. interval between tests (2 to 9 weeks)
c. date and time of initial test
d. enable/disable test.

2.06 BATTERY

A. Description: Valve-regulated, premium, heavy-duty, recombinant, lead-calcium units; factory assembled in an isolated compartment or in a separate matching cabinet, complete with battery disconnect switch.

B. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Contract Drawings or comparable product by one of the following:

1. C&D Technologies, Inc.
2. Eaton Corporation.
3. EnerSys.
4. Panasonic Corporation of North America; Panasonic Industrial Company.

D. Battery Disconnect Breaker: Each UPS system shall have a 250 volt DC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped shunt trip mechanisms and 1A/1B auxiliary contacts. The circuit breakers shall be located within the UPS enclosure or as part of a line-up and match type battery cabinet.

E. Seismic-Restraint Design: Battery racks, cabinets, assemblies, subassemblies, and components (and fastenings and supports, mounting, and anchorage devices for them) shall be designed and fabricated to withstand static and seismic forces.

2.07 INDICATION AND CONTROL

A. General: Group displays, indications, and basic system controls on a common control panel on the front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. An audible signal sounds for alarms as well as the visual indication.

C. Indications: Plain-language messages on a liquid crystal or digital LED display.

2.08 MONITORING BY REMOTE COMPUTER

A. Description: Communication module (RS-485, Modbus TCP/IP) in unit control panel to provide capability for remote monitoring of status, parameters, and alarms identified in the Contract Documents through the SCADA system. The remote computer and the connecting signal wiring are not included in this Section.

B. Data system is covered in Section 16936 "Supervisory Control and Data Acquisition (SCADA) System."

2.09 MECHANICAL FEATURES

A. Enclosures: NEMA 250, Type 1.

B. Ventilation: Redundant fans or blowers draw in ambient air near the bottom of the cabinet and discharge it near the top rear.

2.10 SOURCE QUALITY CONTROL

A. Factory test complete UPS, including battery, before shipment. Include the following tests:

1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.
6. Efficiency test at 50, 75, and 100 percent loads.

B. Observation of Test: Give 14 days' advance notice of tests and

C. Report test results. Include the following data:

1. Description of input source and output loads to be used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
3. List of instruments and equipment required to duplicate factory tests in the field for those tests required to be repeated there.

2.11 BASIC BATTERY MONITORING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Albercorp.
2. BTECH, Inc.
3. Eaton Corporation.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

C. Annunciation of Alarms: At UPS control panel.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documents.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory work, if any, shall be needed to bring the equipment onto the site, and what shall be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 PREPARATION

A. Install any channels, angles or other supports that are required to support or mount the equipment.

B. Verify that UPS room is clean free of debris, water leaks, dust and any other condition that may compromise UPS operations. Floor surface shall be smooth level, free of cracks.

3.03 INSTALLATION

A. Maintain minimum workspace at equipment according to manufacturer's written instructions and NFPA 70.

B. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

3.04 IDENTIFICATION

A. Identify components according to Division 16 Section "Electrical General Requirements."

1. Identify each battery cell individually

3.05 FIELD TESTS

A. Supervised Adjusting and Pretesting: Under supervision of a factory-authorized service representative, pretest system functions, operations, and protective features. Adjust to ensure operation complies with specifications. Load the system using a variable-load bank simulating kVA, kW, and power factor of loads for which unit is rated.

1. Simulate malfunctions to verify protective device operation.
2. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
3. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
4. Test output voltage under specified transient-load conditions.
5. Test efficiency at 50, 75, and 100 percent rated loads.

B. Retest: Correct deficiencies and retest until specified requirements are met.

C. The UPS system shall be considered defective if it does not pass tests and inspections.

D. Seismic-restraint tests and inspections shall include the following:

1. Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.

E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

F. Battery Equalization: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

G. Prepare test and inspection reports.

3.06 CLEANING

A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.07 PERFORMANCE TESTING

A. Engage the services of a qualified power quality specialist to perform tests and activities indicated for each UPS system.

B. Monitoring and Testing Schedule: Perform monitoring and testing in a single 10-day period.

1. Schedule monitoring and testing activity with Authority, through the Engineer, with at least 14 days' advance notice.
2. Schedule monitoring and testing after Substantial Completion, when the UPS is supplying power to its intended load.

C. Monitoring and Testing Instruments: Three-phase, recording, power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at UPS input terminals and at input terminals of loads served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power-line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:

1. Current: Each phase and neutral and grounding conductors.
2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
3. Frequency transients.
4. Voltage swells and sags.
5. Voltage Impulses: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
6. High-frequency noise.
7. Radio-frequency interference.
8. THD of the above currents and voltages.
9. Harmonic content of currents and voltages above.

D. Monitoring and Testing Procedures:

1. Exploratory Period: For the first two days, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these measurements with the objective of identifying optimum UPS, power system, load, and instrumentation setup conditions for subsequent test and monitoring operations.

2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.

   a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS for values indicated, and to highlight the need to adjust, repair, or modify the UPS, distribution system, or load component that may influence its performance or that may require better power quality.

   b. Perform load and UPS power source switching and operate the UPS on generator power during portions of test period according to directions of Authority's power quality specialist.

   c. Operate the UPS and its loads in each mode of operation permitted by UPS controls and by the power distribution system design.

   d. Using loads and devices available as part of the facility's installed systems and equipment, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.

   e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.

E. Coordination with Specified UPS Monitoring Functions: Obtain printouts of built-in monitoring functions specified for the UPS and its components in this Section that are simultaneously recorded with portable instruments in this article.

1. Provide the temporary use of an appropriate PC and printer equipped with required connections and software for recording and printing if such units are not available on-site.

2. Coordinate printouts with recordings for monitoring performed according to this article, and resolve and report any anomalies in and discrepancies between the two sets of records.

F. Monitoring and Testing Assistance by Contractor:

1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.

2. Observe monitoring and testing operations; ensure that UPS and distribution and load equipment warranties are not compromised.

3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by power quality specialist. Specialist shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.

4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.

G. Engage the services of the UPS manufacturer's factory-authorized service representative periodically during performance testing operations for repairs, adjustments, and consultations.

H. See Appendix "A" for documentation and report requirements.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Authority's maintenance personnel as specified below:

1. Train Authority's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Review data in the operation and maintenance manuals. Refer to Division 16 Section "Operation and Maintenance Manuals.".

END OF SECTION

DIVISION 16

SECTION 16611

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

APPENDIX A

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data: Include data on features, components, ratings, and performance for each product specified in this Section.

B. Submittals

1. System configuration with single-line diagrams.
2. Functional relationship of equipment including weights, dimensions, and heat dissipation.
3. Descriptions of equipment to be furnished, including deviations from these specifications.
4. Size and weight of shipping units to be handled by installing contractor.
5. Detailed layouts of customer power and control connections.
6. Detailed installation drawings including all terminal locations.

C. Shop Drawings: Detail fabrication, internal and interconnecting wiring, and installation of UPS system. Include dimensioned plan, elevation views, and details of control panels. Show access and clearance requirements. Differentiate between field-installed and factory-installed wiring and components.

D. Product Certificates: Signed by manufacturers of UPS systems certifying that the products furnished comply with requirements.

E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article.

F. Factory Test Reports: Comply with specified requirements.

G. Field Test Reports: For tests specified in Part 3.

H. Maintenance Data: For system and products to include in the maintenance manuals specified in Division 1. Include the following:

1. Lists of spare parts and replacement components recommended to be stored at the Project site for ready access.
2. Detailed operating instructions covering operation under both normal and abnormal conditions.

I. Warranties: Special warranties specified in this Section.

J. UPS Delivery Submittals

Submittals upon UPS delivery shall include:

1. A complete set of submittal drawings.
2. Two (2) sets of instruction manuals. Manuals shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

PERFORMANCE TESTING

K. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Coordinate simultaneous recordings made on UPS input and load circuits.

L. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in the report:

1. Description of corrective actions performed during monitoring and survey work and their results.
2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
5. Recommendations for operating, adjusting, or revising UPS controls.
6. Recommendation for alterations to the UPS installation.
7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.
8. Recommendations for power distribution system revisions.
9. Recommendations for adjusting or revising electrical loads, their connections, or controls.

DIVISION 16

SECTION 16620

DIESEL-GENERATOR SET

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for a complete diesel-generator set with auxiliaries.

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Sub-Base Fuel Tank.
5. Performance requirements for sensitive loads.
6. Load bank.

1.02 REFERENCES

The following is a listing of the publications referenced in this section:

American National Standards Institute (ANSI)

ANSI B 16.5	Pipe Flanges and Flanged Fittings
ANSI B 31.1	Power Piping
ANSI B 40.2	Gauges and Indicators, Pressure and Vacuum – Indicating Digital Type
ANSI C 12.11	Instrument Transformers for Metering Purposed, 15 kV and Less
ANSI C 37.2	Electrical Power System Device Function Numbers
ANSI C 37.90	Relays and Relay Systems Associated with Electric Power Apparatus
ANSI C 39.1	Electrical Analog Indicating Instruments
ANSI C 97.1	Low-Voltage Cartridge Fuses 600 Volts or Less

American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code

American Society for Testing and Materials (ASTM)

ASTM A 53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM A 106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 120	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM A 135	Electric-Resistance-Welded Steel Pipe
ASTM A 181	Forgings, Carbon Steel, for General-Purpose Piping
ASTM B 221	Aluminum and Alumina-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM A 234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 527	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality

Diesel Engine Manufacturers Association (DEMA)

DEMA	Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines

Federal Specifications (FS)

FS W-B-134	Battery, Storage, (Lead-Acid, Industrial Floating Service)
FS VV-F-800	Fuel Oil, Diesel
FS WW-P-521	Pipe Fittings, and Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt-Welding) Class 150
FS WW-V-51	Valve, Angle, Check, and Globe, Bronze (124, 150 and 200 Pound) Threaded End, Flange Ends, Solder Ends and Brazed End, for Land Use
FS WW-V-54	Valve, Gate, Bronze (125, 150 and 200 Pound, Threaded Ends, Flange Ends, Solder Ends, and Brazed Ends, for Land Use)
FS ZZ-H-428	Hose; Non-Metall8ic and Hose; Preformed: (For the Coolant Systems of Automotive and Other Liquid-Cooled Engines)

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 43	Testing Insulation Resistance of Rotating Machinery
IEEE 115	Test Procedures for Synchronous Machines
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

Military Standards (MIL STD)

MIL L-2104	Lubricating Oil, Internal Combustion Engine, Tactical Service
MIL T-52777	Tanks, Storage, Underground, Glass Fiber Reinforced Plastic

National Electrical Manufacturers Association (NEMA)

NEMA AB 1	Molded Case Circuit Breakers
NEMA EI2	Instrument Transformers
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
NEMA PB 2	Deadfront Distribution Switchboards
NEMA PV 5	Constant Potential Type Electric Utility (Semiconductor Static Converter) Battery Chargers
NEMA SG 3	Low-Voltage Power Circuit Breakers
NEMA SG 4	Alternating-Current High-Voltage Circuit Breakers
NEMA SG 5	Power Switchgear Assemblies

National Fire Protection Association (NFPA)

NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code (NEC)
NFPA 99	Health Care Facilities
NFPA 110	Emergency Power Supplies

International Building Code (IBC)

Underwriter's Laboratories

UL 142	Sub-base Tanks
UL 1236	Battery Chargers
UL 2200	Stationary Engine Generator Assemblies

1.03 QUALITY ASSURANCE

A. The equipment supplied shall be new and standard product of the diesel-generator manufacturer, who shall be the single source responsibility for warranty, parts, and service.

B. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

C. Diesel-generator sets, of the size and type required, shall have been satisfactorily used for purposes similar to those intended herein for not less than five years.

D. Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number and catalog number on a plate secured to the equipment.

E. Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, parts that's are of such a nature or are so located as to be a hazard to operating personnel, shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed in such manner that proper operation of the equipment is not impaired.

F. Welding procedures and welders shall be qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code. Welding procedures qualified by others shall be accepted as permitted by ANSI B 31.1

G. Where materials or equipment are specified to comply with requirements of the referenced publications, evidence of such compliance shall be submitted. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services stating that the items have been tested and conform to the requirements of this Section.

H. The diesel-generator set, all the components, and the means of their attachments and supports shall be designed and constructed to resist the effects of earthquake motion determined in accordance with International Building Code for seismic design category C. For the purpose of classification, this equipment and its enclosures are considered to be emergency or standby electrical equipment. Submit certification of the above requirements to the Engineer.

I. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 75 miles of the Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing

Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Delivery parts, components, and accessories in manufacturer's original, unopened, protective packaging. All equipment shall be properly packed and mounted on pallets or skids to facilitate the handling.

B. Store parts, components and accessories, including engine-generator set, in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Touch up any damage to finishes to match adjacent surfaces.

E. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

F. Replace engine oil and fuel-oil filters after completion of all load testing.

G. Top-off fuel storage tank after completion of all testing.

1.03 SPARE PARTS

A. Submit a complete list of spare parts for approval by the Engineer.

B. Furnish spare parts in containers or packaging to protect parts from damage. Clearly mark each package to identify the parts contained therein.

C. Furnish two spare engine oil filters and two spare fuel-oil filters and the associated gaskets.

D. Furnish two spare air filters and associated gaskets, per intake.

E. Furnish ten spare lamps and fuses, for each type provided as part of the equipment.

F. Furnish two engine, fan alternator or pump belts, for each type provided as part of the equipment.

G. The Contractor, or his authorized representative, shall confirm that there are a minimum of three (3) established agencies with the Port Authority district, which stock a full inventory of spare parts for the system supplied. In the event that there are not three (3) sources of supply, the Contractor warrants that all system components shall be made available by the Contractor for a period of ten (10) years from the date of acceptance of the system.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Furnish ten sets of suitable bound Operation and Maintenance Manuals outlining step-by-step procedures required for system start-up and operation. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of each equipment and component and its basic operation features. Prior to issuance of the certificate of final completion, prepare and submit to the Engineer for approval Operation and Maintenance Manuals in accordance with the requirements of the section 16001, entitled Operation and Maintenance Manuals.

B. Maintenance manuals listing routine maintenance procedures, possible breakdowns, and repairs shall be furnished. The manuals shall include schematic and wiring diagrams for the system as installed.

C. Framed instructions under glass or in laminated plastic, including wiring and control diagrams schematically showing the key mechanical and electrical control elements and complete layout of the entire system, shall be posted where directed by the Engineer. Condensed operating instruction explaining control sequence and preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted for approval by the Engineer, prior to posting. The framed instructions shall be posted before acceptance testing of the systems.

1.05 TRAINING

A. Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval curricula, in accordance with the requirements of the Section. Topics shall cover all of the items contained in the Operation and Maintenance Manuals, including control operation, schematics, wiring diagrams, meters, indicators, warning lights, shutdown system, and routing. Conduct a training course for Authority operating staff. The training period of a total of 8 hours of normal working time shall start after the system is functionally completed but prior to final acceptance tests.

1.06 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Coordinate conduit sizes and routing through the concrete base. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.07 SUBMITTALS

See Appendix A for Submittal Requirements.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER

Subject to compliance with requirements of the Section, provide diesel-generator set(s) of manufacturers as shown on the Contract Drawings.

2.02 RATINGS

Subject to compliance with requirements of this Section, provide diesel-generator set ratings shall be as shown on the Contract Drawings and in conformance to DEMA standard practices.

2.03 CONSTRUCTION FEATURES

Provide labor, materials, equipment and service for a complete installation of diesel engineer-driven generator set(s), equipped with all operating accessories such as: engine/generator control panel, generator output protective circuit breaker, governor, exciter regulator, starting batteries, battery charger, vibration isolators, sub-base double wall fuel tank, fuel-oil piping, automatic transfer switch, remote annunciator, resistive load band, weatherproof enclosure.

The diesel engine-driven generator set shall consist of a diesel engine coupled to a single bearing generator, all mounted on a common base. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails. Sub-base fuel tank shall be the structural base supporting the engine genset. Operation shall be fully automatic upon normal source power failure.

A. Engine

1. The engine shall be of the general purpose, stationary, direct injection, full compression-ignition diesel type, liquid cooled, 4-cycle, in-line or V-type with solid cast iron or steel block. The engine shall have not less than 4 or more than 20 cylinders. The engine may be either naturally aspirated, scavenged, or supercharged. The engine shall operate without excessive smoke, overheating, or mechanical damage when driving the generator under the specified conditions.

2. The engine shall develop the required horsepower when operating on DF-2 diesel fuel conforming to FS VV-F 800 and with lubricating oil conforming to MIL L-2104 of the type and grade as recommended by the engine manufacturer. The engine shall be started and stopped, and run on DF-2. The engine shall have a standard published net available

continuous horsepower rating which, when corrected for specified operating conditions, generator efficiency and after subtracting power for engine and electric driven accessories, auxiliaries and other losses shall be not less than that required to drive the generator continuously at 100 percent of rated full load and 110 percent of rated load for 2 hours out of any 24 consecutive hours of operation. The 100 percent full load rating of the engine shall be the horsepower that the engine shall deliver continuously at is coupling or flywheel when in good operating order and under the specified conditions.

3. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

B. Engine auxiliaries

1. Fuel pump shall be of positive-displacement engine-driven type, and shall supply an adequate quantity of fuel under all conditions of operation. A relief valve shall prevent the buildup of excessive pressure in the discharge line.

2. The system shall be pressurized by one or more engine-driven lube-oil pumps, and shall conform to NFPA 30 and NFPA 37. Pressure shall be regulated by an appropriate relief valve or other approved means. Pipe connections shall be provided for draining the engine. Each engine shall have a dip stick oil-level indicator. The engine shall be wet sump type.

   a. The proper amount of clean lube oil conforming to MIL-L-2104 shall be furnished for each engine. Oil entering pressurized parts of the engine shall pass through a full-flow filtering system consisting of a strainer, lube-oil pumps and a filter, connected in series and in the order listed. The lube oil system shall permit addition of lubricating oil with the engine operating. The strainers and filters shall be in accordance with the engine manufacturer's recommendations. Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

   b. Strainer and filter inlet and outlet connections shall be plainly marked. Strainer and filter elements and filter elements shall be designated to be changed without disconnecting the piping or disturbing other engine equipment. Lubricants and greases shall be provided as required to service the generator sets for initial start up, testing and operation.

   c. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Jacket-water cooling system shall be of the closed loop type, with radiator factory mounted on engine-generator set skid unless otherwise indicated on the Contract Drawings, and shall be arranged to prevent rust and minimize the formation of scale deposits within the engines, and to circulate jacket-water throughout the engine of the temperature and flow rate recommendation. By the engine manufacturer.

   a. A self contained fail-open thermostatic control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature. As recommended by the diesel-engine manufacturer. Cooling system coolant shall by a combination of water and ethylene-glycol. Cooling system operation shall be

fully automatic while the engine is running. Water temperature differential across engine block shall be not more than 15 degrees F. at full load. Failure of the cooling system resulting in over temperature shall stop the engine.

b. Jacket-water centrifugal circulating pump shall be engine driven. Pump capacity shall be adequate for the application. Coolant shall be a solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

c. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

d. Skid-mounted radiator and cooling system rated for full load operation in the ambient temperature based on 0.5 in H_2O external static head. Radiator shall be sized based on a core temperature which is 10°C higher than the rated operation temperature. Radiator shall be provided with a duct adapter flange. Radiator shall be rated for circulated coolant, and shall be fin-and-tube or stacked corrugated-sheet type and constructed of non-ferrous metals.
   1) Size of radiator shall be adequate to contain expansion of total system coolant from cold start to 110 percent load condition, when operating with a cooling air temperature of 100 degrees F. at 500 feet above sea level.
   2) Supports shall be as necessary for the mounting indicated.
   3) Radiator shall be pressure type incorporating a pressure valve, vacuum valve and a radiator cap. Radiator cap shall be designed for pressure relief prior to removal.
   4) Cooling system shall be capable of withstanding a minimum pressure of 7 psig.
   5) A strong grille or screen guard shall protect the radiator.
   6) Hose shall conform to FS ZZ-H-428, grade B. Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet, and abrasion-resistant fabric.
      a) Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
   7) Tapped holes not less than 3/8 inch NPT shall be located at the lowest points in the cooling system, and shall be plugged or equipped with drain cocks.
   8) The engine cylinder head or outlet header shall incorporate a high-coolant-temperature safety device.
   9) Radiator fan shall be propeller type with four blades or more. Tip speed shall not exceed 17,000 feet per minute, driven by the engine through a suitable V belt drive or reduction gears.
   10) The Fan and Fan drive system shall be adequately shrouded and guarded to protect personnel form injury.
   11) Thermostatic control valves in the jacket coolant, shall maintain temperatures within ranges specified.

e. Ductwork for the diesel engine air cooling system shall be galvanized iron or steel sheets or aluminum sheets. Gauges, reinforcements, and fabrication, including hangers and supports shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. The ducts shall be straight and smooth on the inside, with joints neatly finished. The ducts shall be anchored

securely to the building and shall be installed so as to be completely free from vibration under all conditions of operation. Ducts shall be properly braced and reinforced with angles or other structural members. Internal ends of slip joints shall be installed in the direction of flow. A flexible connection shall connect the diesel engine radiator and the ductwork. Material shall be wire-reinforced glass fabric of suitable weave and weight. The connection shall be rendered practically air tight in a manner approved by the Engineer.

f. Provide full coolant charge, suitable for operation down to -10 degrees F entering cooling air temperature.

4. Combustion air intake equipment shall include an air filter, in accordance with the engine manufacturer's recommendation. Each type air filter shall have ample capacity and be suitable for connection to the engine air-intake opening element. Expansion elements in air-intake lines shall be rubber.

5. Exhaust piping shall provided as shown on the Contract Documents. Where a V-type engine is provided, a V-type connector, with all necessary flexible sections and hardware, shall connect the engine exhaust outlets to a single exhaust pipe sized to reduce gas velocity to less than 5,000 feet per minute. Fittings shall be flanged type.

   a. Flexible exhaust section shall be convoluted seamless tube without joints or packing, designed especially for diesel-engine operation, and capable of absorbing vibration of the engine and of compensating for thermal expansion and contraction. Flanges shall be 125 pound type, plain-faced, drilled, and of dimensions to match the flanged exhaust outlet of the diesel engine.

   b. Provide a balanced, stainless steel flapper type rain cap on a vertical exhaust.

6. Starting System.

   a. Provide an electric starting system, arranged for both manual starting and fully automatic starting actuated by contacts in the automatic transfer switch.

   b. The engine shall be started by means of a 24-volt automatic starting system energized by storage batteries. The automatic starting system shall be mounted in the engine/generator control panel.

   c. The engine shall be equipped with a heavy duty positive engagement electric starter motor of sufficient capacity to crank the engine/power generator rotor combination at sufficient speed to allow full diesel starting when conditioned to, and in ambient temperature of 32 degrees F. (indoor) or -10 degree F. (outdoor), in conjunction with the specified fuel and lubricants. Starting system, including batteries, shall be adequate to crank the engine for a minimum of four cranking periods without overheating. The cranking cycle shall consist of four cranks of 15 seconds, each, with three 15 second rest periods between the cranks. If the engine fails to start after the cranking cycle has been completed, the control shall lock out, and actuate the overcrank signal light on the control panel and sound an audile alarm. The cranking motor shall be automatically disengaged with the engine accelerates to 600 RPM by means of a suitable speed sensing circuit.

   d. Storage battery shall be nickel cadmium cranking batteries complete with battery rack, intercell connectors, and battery-to-engine cables, all in conformance with

manufacturer's requirements. The battery capacity shall be compatible with the cranking duty described in preceding paragraph, in an ambient temperature of 40 degrees F. Batteries shall conform to FS W-B-134. Battery capacity shall provide a minimum of 60 seconds of total cold cranking time.

e. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature. Include accessories required to support and fasten batteries in place.

f. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

g. Battery charger shall be adequate to recharge the fully depleted battery in not more than 8 hours and shall automatically control the rate of charge, providing a high-charge rate to a depleted battery and reducing to a trickle-charge rate when the battery is fully charged. Charging rate shall be adjustable. Battery charger shall comply with NEMA PV 5 and UL 1236.

1) It shall contain a DC ammeter and voltmeter, a fused input and output and completely isolate the AC input from DC output.

2) Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

3) Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

4) Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

5) Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

6) Battery charger shall be housed in a NEMA 250 type 1 enclosure suitable for wall mounting. It shall be provided with battery charger malfunction and low voltage DC alarm relay.

7. The engine shall be provided with thermostatically controlled tank type coolant heaters to maintain engine block coolant temperatures in the range of 100 - 120 degrees F for reliable automatic starting at the ambient temperature range stated herein. The heaters shall automatically disconnect when the engine starts and shall be provided with hand shutoff valves to facilitate service without draining cooling system. The coolant heater shall be UL 499 listed and labeled

C. Generator

1. The generator shall be a three phase synchronous type, brushless design, single bearing, with a 4 pole rotor coupled directly to the engine flywheel through a flexible drive disc to maintain permanent alignment. The generator housing shall be bolted directly to the flywheel housing of the engine and shall be capable of withstanding the combined stress of the supported engine weight and anti-torque reactions without distress. Enclosure

shall be close coupled, drip proof construction. The generator shall be capable of 10 percent overload for 2 hours in any 24-hour period of operation without exceeding temperature rise indicated in NEMA MG 1. Design shall be such as to protect against mechanical, electrical, and thermal damage due to vibration, 25 percent over-speed, or voltage, and 10 percent overload. The generator shall meet all requirements of NEMA MG-1, Part 22, in design, performance, and factory test procedures.

a. Permanent Magnetic Excitation System: The generator shall be equipped with a permanent magnet generator (PMG) excitation system. The output of the PMG shall be used to supply power to the voltage regulator and to effectively isolate the regulator power circuits from the distortion that occurs when the generator supplies large non-linear loads. Both the PMG and the rotating brushless exciter shall be mounted outboard of the bearing for ease of service. Under short circuit conditions, the system shall be capable of sustaining 300 percent of rated current for 10 seconds. The rotating rectifier shall use a three-phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector.
b. Insulation System: The insulation system of both the rotor and the stator shall be NEMA class F or H materials and shall be synthetic, non-hydroscopic, and fungus resistant. The stator winding shall be given multiple dips and bakes of varnish, plus a final coating of epoxy for extra moisture and abrasion resistance.
c. Main Rotor: The rotor shall be dynamically balanced for operating speeds up to 125 percent of rated speed and shall have full amortisseur windings. The main rotor core shall be shrunk-fit and keyed to the shaft.
d. Stator Windings: The stator winding shall be of 2/3-pitch design to minimize the third harmonic and be random wound.
e. Bearing: The rotor bearing shall be pre-lubricated, shielded, ball type with provisions for adding grease.
f. Ventilation and Cooling: The generator shall be self-ventilated and have a one-piece cast aluminum alloy, low noise cooling fan.
g. Actual temperature rise measured by resistance method at full load shall not exceed 1058C in a 408C ambient.
h. Conduit Load Connection Box: The generator shall be furnished with a ventilated end mounted load connection box that shall allow entry of the load cable conduits through the top, bottom, or either side.
i. Voltage Regulator: The voltage regulator shall be completely solid state with electronic components encapsulated for protection against vibration and atmospheric deterioration. The regulator shall include three phase RMS sensing, true volts per hertz operation with adjustable cut in and provision for parallel operation. It shall be unit mounted within the generator set terminal box with suitable space for remote connections and control wire terminations.

    1) A voltage adjusting rheostat shall be provided on the control panel to permit a +/- 10 percent adjustment in generator voltage.

j. Performance: the performance of the generator when driven by the diesel engine shall be as follows:

    1) The unit shall be capable of reaching full rated voltage and frequency within 10 seconds of receiving a start signal and accepting full rated load in one

step under the ambient temperature conditions specified herein. Start Time: Comply with NFPA 110, Type 10, system requirements.

2) Voltage regulation shall be +/- 0.5 percent maximum deviation from rated generator terminal voltage between no load and full load 0.8 power factor under steady state condition.
3) Voltage transient deviation shall be 20 percent maximum from rated generator terminal voltage on one step application or removal of full load when generator is driven by diesel engine.
4) Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
5) Frequency regulation shall be +/- 0.25 percent maximum deviation from rated generator terminal frequency at any constant load from no load to rated load.
6) Frequency transient shall be 12 percent maximum deviation from related generator terminal frequency on one step application or removal of full load at each 0.8 or 1.0 power factor when generator is driven by diesel engine.
7) Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
8) Voltage and frequency transient recovery time be 3 seconds maximum for one step application or removal of full load at either 0.8 or 1.0 power factor from the time the generator terminal voltage and frequency leaves the respective regulation limits, to the time the generator terminal voltage and frequency recovers within respective regulation limits when generator is driven by diesel engine.
9) Electromagnetic interference suppression shall not exceed the specified in MIL-STD-461B, part 9.
10) Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
11) Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
12) Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
    a) Provide permanent magnet excitation for power source to voltage regulator.

2. Connections

a. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings. Generator set feeder distribution shall be wall mounted and compliant to code requirements for conductor sizing, isolation of devices, and isolation of service types.
b. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

c. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

3. The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

D. Engine/Generator Control Panel

1. The engine generator shall be provided with a control panel, in a NEMA 1 type 14 gauge steel enclosure, or as shown on the Contract Drawings. It shall be mounted on the generator set, with suitable vibration isolators, and incorporate solid state microprocessor based control circuitry, sealed dust tight, watertight modular components with metal housing and digital instrumentation. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. Instruments shall be back connected and flush mounted. The panel shall include the following equipment:

a. Generator AC Output Metering Devices, as required by NFPA 110 for Level 1 system

1) AC Voltmeter, 2 percent accuracy
2) AC Ammeter, 2 percent accuracy.
3) Combination voltmeter/ammeter selector switch
4) AC Frequency meter
5) DC voltmeter (alternator battery charging).
6) Engine-coolant temperature gage.
7) Engine lubricating-oil pressure gage.
8) Ammeter-voltmeter, phase-selector switch(es).
9) Generator-voltage adjusting rheostat.
10) Fuel tank high-level shutdown of fuel supply alarm

b. Fault shutdown circuits with individual visual and audible indications for:

1) High jacket coolant temperature
2) Low oil pressure
3) Engine overspeed
4) Engine overcrank
5) Low coolant level

c. Engine Control and Monitoring Devices:

1) Automatic/manual start-stop control
2) Emergency stop pushbutton
3) Manual-of-auto selector switch

d. Alarm circuits with individual visual and audible indications for:

1) Pre-high jacket coolant temperature
2) Pre-low oil pressure
3) Low coolant temperature
4) Control switch not in Auto

5) Battery charger malfunction
6) Low battery voltage
7) Low fuel level

e. Alarm horn and silence switch
f. Voltage adjust rheostat
g. Governor speed adjust rheostat
h. Running time meter
i. Remote connection provision for any system fault
j. All necessary control wiring, fuses, fuse blocks, terminal blocks, nameplates, auxiliary contacts, etc.

1) The mutable alarm horn shall annunciate any alarm condition. At the same time a blinking visual signal shall indicate the cause of alarm. If an emergency device stops the engine, the visual signal shall stop blinking, but remain on and indicate the cause of failure.
2) Installation shall comply with ANSI B40.2, ANSI C12.11, ANSI C 37.2, ANSI 37.90, ANSI C 39.1, and ANSI C97.1.

2. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

3. Connection to Data Link:
a. Communication module (RS-485, Modbus TCP/IP) in unit control panel to provide capability for remote monitoring of status, parameters, and alarms identified in the Contract Documents through the SCADA system.
b. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.
c. Data system is covered in Section 16936 "Supervisory Control and Data Acquisition (SCADA) System."

4. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition shall reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

5. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

E. Generator Circuit Breaker

1. An enclosed generator mounted main line circuit breaker shall be provided within the generator set terminal box to protect the unit from overcurrent and short circuit conditions. The breaker shall be installed within an enclosure as specified on the Contract Drawings, of suitable size which shall allow for proper bending radius of all conductors as per National Electrical Code. Lugs and supports shall be included. Installation shall comply with NEMA SG3 and NEMA SG4.

2. Circuit breaker shall be supplied with 24VDC shunt trip device and ground fault trip.

   a. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

3. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

   a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   b. Trip Settings: Selected to coordinate with generator thermal damage curve.
   c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
   d. Mounting: Adjacent to or integrated with control and monitoring panel.

4. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator shall occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
   a. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
   b. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
   c. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
   d. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

F. Engine Governor System

1. An engine governor system shall be provided to maintain engine speed within the limits specified herein from no load to rated load. The governor shall be adjustable isochronous, with speed sensing. Steady state frequency regulation shall be +/-.25 percent. Governor speed droop shall be adjustable from 0 to 10 percent from no load to full rated load. A remote speed adjusting potentiometer shall be mounted in the control panel

G. Fuel Oil System

1. Furnish a complete fuel oil system, as specified in this Section, as shown on the Contract Drawings and in accordance with NFPA 30 and NFPA 37.

   a. Provide a main fuel double wall sub-base storage tank, with capacity as shown on the Contract Drawings, with locking fill cap and all necessary tank fittings, as shown on the Contract Drawings and in accordance with MIL T-52777.
   b. The sub-base day shall be designed as a seismically secure support for the engine/ generator set it supports. The sub base tank shall be anchored to the generator's

isolated concrete base. The engine/ generator shall be mounted to the sub-base tank with seismically restrained spring isolators.

c. The sub-base tank containment shall have a capacity of 110 percent of nominal capacity of sub-base tank. The sub-base tank shall be mounted so as to provide a flooded suction to the engine if so recommended by the manufacturer. Sub-base tank shall be provided with transfer pump and connections for the fuel supply, fuel overflow return, fill, vent and drain pipes. Provide a manual (hand) pump for emergency operation. A double pole float switch on tank shall control a solenoid valve and start the transfer pump on low level and stop it at high level. The solenoid valve shall be installed in the fill line for operation with 120 volt 60 Hz single phase AC. Positive means shall be provided to prevent fuel oil leakage from sub-base tank through injectors into the engine cylinders, when the engine is not running.

d. Provide a fuel leak detection panel to monitor the interstitial space between the tank walls and alarm upon detection of hydrocarbons in the interstitial space. Detection panel shall monitor fuel level and alarm upon high (over-fill) level and low level (tank re-fill). Detection panel shall display the fuel remaining in the tank in gallons.

e. Provide one duplex, full-flow strainer and one duplex, full-flow filter for each engine. Strainer shall be located on the suction side. When the pump and the high pressure injector equipment are contained in a common housing, the fuel filter may be located between strainer and engine fuel pump. Strainer shall be metal-edge or screen type with a maximum opening of 0.007 inch (80 mesh). Filter case shall be compatible with the filter elements. Strainer and filter shall have inlet and outlet connections plainly marked and shall be mounted in accessible locations. Strainer and filter elements shall be designed to be changed without disconnecting the piping or disturbing other engine components and shall be so valved and arranged as to permit changing without shutting down the engine. An indicating differential pressure gauge shall be provided across the inlet and outlet sides of the filters. A pressure gauge with red line limit shall be provided at the inlet side.

H. Provide complete piping systems for fuel oil from sub-base storage tank, to the generator set. Only black iron or wrought steel pipe shall be used for fuel oil.

1. Connections shall ensure unrestricted circulation and permit complete drainage of the system.

I. Load Bank

1. The load bank rating shall be as specified on the Contract Drawings. The load bank shall be a completely self-contained unit for mounting in the radiator air stream, unless otherwise shown on the Contract Drawings. The UL listed, radiator style resistive load bank shall include all resistive load elements, load control devices, and protective devices.
2. The load bank shall be listed to UL Standard 508A. The load bank shall be suitable for installation on the generator radiator core, or within the radiator exhaust ductwork. The load bank shall be constructed of heavy gauge aluminized steel per ASTM A463.
3. The resistive elements shall be made of helically wound chromium alloy wire. Resistive elements shall be continuously supported by a ceramic insulated steel rod, securely held at each end. The resistive load steps shall be additive and arranged as shown on the Contract Drawings. The total load shall terminate to a single, 3-phase distribution block.

4. The overall tolerance of the load bank shall be –0% to +5% KW at rated voltage. The load bank must deliver full rated KW at rated voltage.
5. The load bank shall have an over temperature sensor mounted in the top of the core. The switch shall be electrically interlocked with the load application controls to prevent load from being applied in the event of an over temperature condition.
6. Load step fusing shall be provided. Branch fuses shall be provided on all three phases of switched load steps above 50KW. Branch fuses shall be current limiting type with an interrupting rating of 200K A.I.C.
7. The controls shall be housed in a Control Panel, including switches for each load step, a master control switch, and power ON-OFF switch. Control Panel is an integral part, located on the side of the load bank. Control panel visual indicators shall be as follows: Power On indication light. and Over-Temperature light.
8. A standard remote load dump circuit shall be provided as part of the load bank control circuit. Provisions shall be provided to remove the load bank off-line from the operation of a remote normally closed set of auxiliary contacts from a transfer switch or other device. In the event of the remote contact opening, all load is removed.

J. Site Condition

1. The operating environment of the diesel-generator set shall be as follow:

   a. Altitude: 500 Feet Above Sea Level.
   b. Max. Ambient Fan: 120 degree Fahrenheit.
   c. Min. Ambient Temperature: -10 degree Fahrenheit.
   d. Relative Humidity: 20 to 100%.
   e. Coolant System Engine Mounted Radiator.

2.04 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Provide seismically restrained 1-inch deflection spring isolators to support the engingine generator.
2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
3. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.05 PAINTING

A. Unless otherwise specified, surfaces of equipment and component items shall be cleaned, primed and finished painted in accordance with the manufacturer's standard practice.

2.06 FACTORY TESTS

A. Prototype Tests

1. The diesel-generator set design shall have been tested as a complete unit, on representative engineering prototype models, in conformance to the requirements of NFPA 110, IEEE 43, IEEE 115 and MIL STD 705. Certified test data shall be submitted to the Engineer.

B. Production Tests

1. Fully test the diesel-generator set with all mounted appurtenances prior to the shipment to the job site. Diesel-generator set shall receive the manufacturer's standard production test of the completely assembled engine, generator, radiator, control panel, and mounting base. The manufacturer shall provide written certification and documentation supporting compliance with test requirements.

2. The following equipment shall be tested at the manufacturer's plant before shipment:

   a. Diesel-generator set:

      1) Diesel generator, production test procedure shall be approved by Engineer. The diesel-generator set shall be tested under balance, rated load and 80% power factor for performance and functioning of control and interfacing circuits. Testing at unity power factor only is not acceptable. Test shall include:

         a) Single step load pick-up per NFPA 110.
         b) Transient and voltage dip response and steady state voltage and speed (frequency) checks.
         c) Visual inspection and functional test for lube-oil pump, cooling system, exhaust system, and starting system.

      2) Generator Control Panel Control panel production test procedure shall be approved by Engineer.

      3) Battery charger.

         a) The battery charger test procedure shall be based on NEMA PV-5 standards and shall be approved by Engineer.
         b) Factory test, as outlined above, shall be witnessed by the Engineer. The Manufacturer shall notify the Engineer two (2) weeks prior to the date the tests are to be performed.

      4) The load bank shall be fully tested. Tests shall include electrical functional testing, verifying conformance to assembly drawings and specifications. Each load step shall be cold resistance checked to verify proper calibration of resistive load steps and proper ohmic value.

PART 3 - EXECUTION

3.01 EXAMINATION

A. After the system equipment has been delivered, an on-site inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this section, the Contractor shall be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

B. The entity manufacturing the equipment shall provide on-site technical supervision and assistance during installation and interconnection of the system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the final acceptance test.

3.03 INSTALLATION

A. Install diesel-generator, auxiliaries and appurtenances as shown on the Contract Drawings, in accordance with manufacturer's instructions, NFPA 70, NFPA 30, NFPA 37, NEMA MG 2, other applicable codes and standards, and as specified herein. In case of conflict, consult the manufacturer before proceeding with installation.

B. Install level concrete foundation and pad, including conduits, piping and anchor bolts, as shown on the Contract Drawings and in accordance with the manufacturer's instructions and approved shop drawings.

C. Interconnect all equipment, for proper operation.

D. Excavation and backfill for fuel storage tank and conduit and piping systems shall be as specified in the Section of the Specifications entitled "EXCAVATION, BACKFILLING AND FILLING".

E. Concrete Work shall be as specified in the Division 3 - Concrete - of the Specifications.

F. Install a complete grounding system for the diesel-generator set and enclosure as shown on the Contract Drawings and as specified in the Section of the Specifications entitled "GROUNDING".

3.04 FIELD TESTS

A. Before being covered, enclosed or placed in use, all fuel-oil piping shall be hydrostatically tested with the normal system fluid to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 5 psig at the highest point of the system. This test shall be maintained for a sufficient time to complete a visual inspection of all joints and connections, but for at least 10 minutes. Upon completion of the testing, the piping shall be properly connected and filled with the fuel oil to be used in the system.

B. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative of the diesel-generator set manufacturer. The engine lubrication oil recommended by the manufacturer shall be provided and installed.

C. Functional Test

1. Upon completion of initial start-up and system checkout, perform a functional test, in the presence of the Engineer, to demonstrate load carrying capability, operation in accordance with the specifications, and voltage and frequency stability.

D. Operational Test

1. Perform a full-load test in compliance with NFPA 110, in the presence of the Engineer. The building loads can serve as part of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate KW rating of the diesel-generator set. Transfer, on a temporary basis and for the duration of testing, any normal loads necessary to establish the specified generator loading. The duration of the full-load test shall be for a minimum of two hours.

   a. Record, throughout the test, time-of-day, coolant temperature, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with all switches transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, battery charger rate, at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter.

E. Provide all labor and materials for functional and operational tests required and furnish the fuel-oil necessary for the load testing. Top-off fuel storage tank after completion of testing.

F. Should the tests reveal any defects in the diesel-generator equipment or auxiliaries installed under this Contract, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer in all respects.

G. Report immediately to the Engineer any defect found in portions of the diesel-generator system not installed under this Contract. Do not attempt to rectify any defect found in a component of the system not installed under this Contract unless specifically instructed to do so by the Engineer.

H. Submit all the test results to the Engineer for final approval.

END OF SECTION

SECTION 16620

DIESEL-GENERATOR SET

(WITH AUXILIARIES)

APPENDIX "A"

SUBMITTALS

A. Shop Drawings

1. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

   a. Electrical wiring diagrams.

   b. Coolant system schematic.

   c. Fuel piping schematic.

   d. Interconnection wiring diagrams, logic and ladder diagrams

   e. General arrangement drawing showing location, size, access, workspace requirements, and dimensions of all components and required interfaces.

      1) Drawing shall provide data required to completely design the foundation for the unit, including anchor bolt layout.
      2) Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
      3) Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
      4) Vibration Isolation Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

   f. Manufacturer Seismic Qualification Certification: Submit certification that sub-base tank, engine-generator set, batteries, battery racks, accessories, and components shall withstand seismic forces defined in Section 16074 "Vibration and Seismic Controls for Electrical Systems." Include the following:

      1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      2) The term "withstand" means "the unit shall remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit shall be fully operational after the seismic event."

g. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

h. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

i. Wiring Diagrams: Power, signal, and control wiring.

j. Transient response data of the engine generator set to 100% block loads at 1.00 power factor. Data shall include maximum voltage dips, maximum frequency dips, and recovery times.

1) Thermal damage curve for generator.
2) *Time-current characteristic curves for generator protective device.*

B. Catalog Cuts

1. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

a. Engine

b. Radiator

c. Generator

d. Engine/Generator control panel

e. Generator output protective circuit breakers

f. Governor

g. Remote alarm annunciator.

h. Vibration isolators

i. Flexible fuel lines

j. Exhaust silencer and flexible connections

k. Fuel sub-base tank and transfer pump

l. Anchor bolts

m. Cranking batteries and rack(s)

n. Battery charger

o. Block heater

p. Battery heater blanket (as required)

q. Resistive load bank (as required)

C. Evidence of material or equipment compliance per 1.03.

D. Spare Parts: Submit a complete list of recommended spare parts per 1.05.

E. Operation and Maintenance Manuals per 1.06.

F. Training curricula per 1.07.

G. Certified Prototype Test compliance per 2.06 A.

H. Certified Production Test compliance per 2.06 B.

I. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

J. Acceptance Testing Plans per 3.04.

1. Prepare and submit to the Engineer for approval an installation acceptance testing plan for the entire system a minimum 30 days in advance of the earliest, approved, scheduled inspection and test date. The system plan shall be divided into the following stages:

a. Inspection upon arrival at the construction site.

b. On-site inspection and test immediately following the complete installation of the system, to demonstrate compliance with the requirements of this section.

c. Operational test commencing with the successful completion of the on-site inspection and test.

2. Field test reports per 3.04.

3. Seismic certification.

4. Record Documents.

a. Prior to issuance of the certificate of final completion, deliver to the Engineer the following:

1) One (1) reproducible set of the Contract Drawings and Shop Drawings. Nine (9) set of prints of said Contract Drawings and Shop Drawings shall be

supplied to the Engineer, three (3) copies of which shall be marked to the attention of the facility Supervisor of electrical maintenance.

2) Nine (9) copies of the final version of the Operation and Maintenance manuals. Three (3) copies of said Operation and Maintenance manuals shall be marked to the attention and the facility Supervisor of electrical maintenance.

END OF APPENDIX "A"

DIVISION 16

SECTION 16670

LIGHTNING PROTECTION SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for a complete lightning protection system.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

Lighting Protection Institute (LPI)

LPI 175	Lightning Protectors Installation Code
LPI 176	Material Standard
LPI 176	Inspection Guide

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 780	Lightning Protection Code
NFPA 781	Lightning Protection Early Streamer Emission Air Terminals Code (Proposed)

Underwriters Laboratories

UL 96	Lightning Protection Components
UL 96 A	Installation Requirements for Lightning Protection Systems

1.03 DESIGN REQUIREMENTS

A. Unless otherwise specified on the Contract Drawings or in this Section, the Lightning Protection System shall be manufactured, supplied, and installed in conformance with the requirements of all local codes, and the Publications referenced in Article 1.02 herein.

B. The Lightning Protection System shall be composed of all items of hardware, cables and grounding electrodes necessary to dissipate the lightning current into the mass of the earth. In general, the system shall consist of readily available listed components that fully comply with the requirements of this Section and the Contract Drawings.

C. The Lightning Protection system shall be designed to prevent damage to building structures and property, injury to occupants, and protection of electrical systems including electronic equipment.

D. The Lightning Protection system shall include but not be limited to the following:

1. The entire roof system, gutters, leaders ventilators, and all other metal appurtenances shall be made electrically continuous and shall be grounded to the grounding grid or in the case of structural steel frame construction directly to the building steel with approved fasteners at intervals averaging not more than 100 feet around the perimeter of the structure.

2. All metallic objects inside the building within 6 feet of the Lightning Protection System or metal connected to it shall be bonded to the system with approved fittings and conductors.

3. Air terminals shall be no more than 20 feet apart with the end terminals no more than 2 feet from the ends of the building.

4. Lightning protection conductors shall interconnect all metallic objects on the protected structure, and shall be installed to provide a two way path to ground from each air terminal, and shall be bonded to the steel framework at each roof beam and a minimum of every 60 feet along the ridge beam.

5. Down conductors shall be installed at all four (4) corners of the building, at columns near the center of the north and south building walls and at other locations as required by the referenced codes and good design. They shall be installed as directly as possible to ground.

6. The design of the Lightning Protection System, including the down conductors, shall be compatible with the architectural features of the building or structure, as approved by the Engineer.

1.04 QUALITY ASSURANCE

A. The Contractor shall engage the services of a UL certified lightning protection installer, who shall have designed and installed Lightning Protection Systems that have been in satisfactory use for not less than three years in a minimum of 20 installations for purposes similar to those intended herein.

B. The lightning protection system design and installation shall conform to the requirements of LPI 175, LPI 176, NFPA 70, NFPA 780, NFPA 781, UL 96, and UL 96 A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging. Protective caps shall be removed immediately prior to installation of conduit.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPARE PARTS

A. The Contractor, or his authorized representative, shall confirm that there are a minimum of three (3) established agencies within the Port Authority District, which stock a full inventory of spare parts for the system supplied. In the event that there are not three (3) sources of supply, the contractor warrants that all system components will be made available by the Contractor for a period of ten (10) years from the date of acceptance of the system.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide a lightning protection system of one of the manufacturers specified on the Contract Drawings.

2.02 MATERIAL

A. General

1. All electrical materials and equipment, shall be labeled or listed by UL for use in Master Labeled Lightning Protection systems. Materials shall be sized in accordance with the materials requirements of NFPA 780 and UL 96A.

2. Generally all materials shall be copper, or copper-bronze (in locations where system components are mounted on aluminum surfaces, aluminum materials shall be used) as specified herein and of the size, weight and construction to suit the application shown on the Contract Drawings and shall be used in accordance with UL and LPI and NFPA code requirements, for class II structures and as per manufacturers recommendations.

B. Conductors

1. Conductors shall be sized in accordance with material requirements above. Down conductors shall be copper.

C. Connections, Splices, and Fasteners

1. Connectors, splicers, fasteners, and cable clamps shall be heavy-duty bronze, approved for lightning protection systems.

2. Bonding plates shall be heavy-duty bronze with a minimum bonding surface of 8 square inches.

3. Fittings for connections to metal tracks, gutters, ventilators, etc., shall be of an approved type and shall be made tight by compression under bolt heads or equivalent.

4. Screws, bolts, nuts, washers and nails shall be stainless steel. Galvanized or plated materials are not acceptable.

D. Roof Penetrations

1. The roof penetrations required for down conductors or for connections to structural steel framework shall be made using thru-roof assemblies.

2. Through the roof connectors shall be bronze, right-angle, thru-roof connectors with clamp type top cable connector, 4 inches square roof flashing plate, 1/2 inches diameter by 15 inches long threaded stem, hex nut and washer, and adjustable bottom cable clamp.

3. Roof flashing shall be compatible with the roofing system.

E. Air Terminals

1. The air terminals shall be as follows:

a. Ridge Type

(1) Air terminal shall be pointed, solid, round, heavy duty, bronze rod for concealed in place installation.

(2) Air terminal shall be 1/2 inches in diameter with a 10-inch nickel tipped point and 15-inch long solid copper stem.

(3) Each air terminal shall be furnished with lead washers, a support bracket for attachment to the ridge member, and an adjustable thru-roof clamp type cable connector.

b. Parapet Type

(1) Pointed, solid, round, heavy duty, bronze rod with 5/8 inches inside threaded adapter for mounting on a point support.

(2) 1/2 inches in diameter with a nickel tipped point and a 24-inch long solid copper stem.

(3) Each terminal shall be furnished with an offset point support and a point extension.

(4) Each offset point support shall be bronze with a 5/8 inch outside thread.

(5) Each point extension shall be bronze, 3 inches long, with a 5/8 inches outside top thread and a 5/8 inches inside bottom thread.

F. Ground Terminations

1. The ground terminations shall be as follows:

a. 5/8" x 10'-0" (minimum) copper-clad rod.

b. Bronze clamp (connecting ground rod and down conductor) having at least 1-1/2" of contact between rod and conductor, or by an exothermic welded connection.

c. Conductors from the ground connections to the ground terminations shall be class II copper lightning conductors.

PART 3. EXECUTION

3.01 INSTALLATION

A. The installation shall be in accordance with LPI 175, LPI 76 and UL 96A.

B. The installation shall he completed by an experienced installer who is a certified Master Installer of the LPI or working under the direct supervision of an LPI manufacturer or his authorized LPI certified Master Installer representative.

C. Terminals shall be installed and all openings sealed in accordance with the Contract Drawings and manufacturers recommendations.

D. Connections to steel framework shall be with bonding plates as described above.

E. Conductors shall be held in place with approved fasteners. Spacing of fasteners shall not exceed 3-foot centers on both horizontal and vertical runs.

F. Approved connectors and splicers as described above shall be used for joining conductors. When attached to conductors they shall be sufficiently tight to withstand a tensile force of two hundred (200) pounds.

G. Down conductors shall be connected to building grounding system with approved fittings. Common grounding of all ground mediums entering the structure shall be ensured by interconnecting to the Lightning Protection System using main size conductors and fittings.

H. The offset point supports for the parapet air terminals shall be shimmed to clear the coping.

I. Conductors for the parapet air terminals shall interconnect all the terminals on the parapet and shall be fastened to the parapet with approved fasteners forming a closed loop around the building. Conductors shall be connected to the down conductors via the thru-roof connector described above.

J. Ground rods shall be located two feet below grade, preferably two feet from foundation walls.

K. Ground rods shall extend a minimum of ten feet vertically into the earth.

L. Grounded metal bodies located within the required bonding distance as determined by NFPA 780 shall be bonded to the Lightning Protection System using bonding connections and fittings.

3.02 COORDINATION

A. The Contractor shall insure a correct, neat and unobtrusive installation.

B. The Contractor shall insure a solid mechanical and electrical connection to the building ground system.

3.03 INSPECTION, TESTING, COMPLETION AND APPROVAL

A. The Contractor shall secure and deliver the LPI System certification to the Engineer upon completion of the installation.

B. The Contractor shall also submit copies of as-built shop drawings with LPI Forms 175A, B and C along with the LPI Certificate System Application.

C. Underwriters' Laboratories Master Label shall be furnished as evidence that the installation complies with the UL 96A requirements.

D. If protected structure is an addition to, or is attached to an existing structure the Contractor shall advise the Engineer of any additional work required on the existing Lightning Protection System or structure with current UL requirements.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16670A01 Shop Drawings –
1. Connection Diagrams
2. Layout drawing, including type, size and location of the following:
   a. All equipment
   b. Cable routing
   c. Ground rods
3. Any special equipment that must be manufactured or fabricated.

Catalog Cuts

16670B01 Catalog Cuts –
1. Wire and cable
2. Air terminals and other equipment
3. Supports, fasteners and hardware

Certificates

16670E01 Certifications –
1. LPI system Certification
2. UL Master Label
3. LPI Forms
   a. 175A
   b. 175B
   c. 175C

Spare Parts List

16670N01 Spare Parts: Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section, for approval by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16721

FIRE ALARM SYSTEM EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for Fire Alarm System Equipment.

1.02 SYSTEM DESCRIPTION

A. The following is a general description of the Work in this Section. The description given here is only a guide to the bidder as to the type and extent of the Work involved in this Section.

1. The scope of work involved with this project encompasses the installation of new Siemens XLS Fire Alarm Systems and devices at the Bayonne Bridge Site, as an extension of the existing Siemens Fire Alarm Control System at the Goethals Bridge Site. The scope of work involves retrofitting the Fire Alarm Systems in the Tolls Administration Building, and 4 new Fire alarm Systems to encompass the general scope of the expansion renovations to the Bayonne Bridge. The Work shall include initial acceptance testing, demolition, installation, building system interfaces, programming, testing, and training necessary to complete the above mentioned scope of work.
2. Contract Drawings are diagrammatical and do not show quantities. The Contractor shall furnish and install a complete and fully operational system. All final quantities of all required parts and pieces to provide said complete system are solely the responsibility of the Contractor under this Contract.
3. The Contractor shall furnish and install all conduits, fittings, outlets, junction boxes, supports, hangers, wire and cable and other items incidental to and/or required to complete the installation, in accordance with the intent of the drawings and specifications. This shall include wire and conduit required to operate both new and existing equipment circuits during each phase of the work.
4. Final quantities of any cabinets, as required, to include transponders, amplifier enclosures, and booster panels shall be coordinated between the Contractor, the electrical Sub-Contractor, and the fire alarm Sub-Contractor.
5. All AC branch circuits required to power all cabinets, panels, and or enclosures as coordinated above shall be included in this scope of work. This information shall be shown on the fire alarm drawings.
6. Failure to coordinate and include any part or piece required to provide an entirely complete and functioning Fire Alarm System, shall not be subject to a change order, and shall be borne solely by the Contractor..
7. The Contractor shall perform all programming and downloads for nodes throughout both Bridge Sites which are affected as a result of each phase of the system modification.

8. The Contractor shall perform graphic display updates to accommodate all changes to the fire alarm system in the NCC graphical user interfaces at both sites. This shall also be completed for each phase of the system modification.

9. The scope of work entails any/all cutting and patching required by the scope of work outlined in the package. All ceiling tiles affected by this project shall be replaced with new tiles.

10. The Contractor shall seal all openings created through fire and smoke barriers with a UL-listed fire/smoke penetration sealant system, in accordance with manufacturer's recommendations.

11. The Contractor shall furnish, install and connect grounding as required by the Code, and as required by the Specifications.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code

NFPA 72 National Fire Alarm Code

NFPA 90A Installation of Air Conditioning and Ventilating Systems

NFPA 13 Installation of Sprinkler Systems

NFPA 92A Smoke Control Systems

Underwriters Laboratories Inc. (UL)

UL 268 Smoke Detectors for Fire Protective Signaling Systems

UL 1971 Notification Appliances for Fire Protective Signaling Systems

UL 864 Control Units for Fire Protective Signaling Systems

Americans with Disabilities Act, PL 101-336 (ADA)

New York City Building Code NYCBC

New York City Electrical Code NYCEC

New York City Fire Prevention Code and Directives

(NJ) International Building Code -NJ ed., 2009

(NJ) National Electrical Code, 2011

1.04 Quality Assurance

A. QUALIFICATIONS

1. Contractor shall have successfully completed at least three (3) installations for fire alarm system work of similar type, size, and complexity, as the Fire Alarm System described in this Specification and the Contract Drawings. Installations shall have been in satisfactory operation for a period of not less than one (1) year, and shall have included at least one contract for the installation of a Fire Alarm System in an existing occupied building. Contractor shall be licensed to perform this type of work. Licensure shall be evidenced by a submission from the entity of the following:

   a. Copy of the Contractor's current license,

b. Business permit and associated certifications.

2. Contractor shall be an authorized installer approved by the System Manufacturer. Proof of such authorization shall be provided to the Engineer prior to the commencement of any Work.

3. System Manufacturer: The System Manufacturer shall be one of established reputation and experience in the fire alarm industry. The Manufacturer shall have been in business a minimum of five (5) Years, show substantial involvement in the development and manufacture of systems similar to the one specified in this contract and have a minimum of (3) three qualified factory authorized full line distributors and or branch offices within fifty (50) miles of the System location. The Manufacturer shall also have an in-house technical support staff accessible to the Authority for technical assistance over the phone, offer detailed technical training courses both on site and at the Manufacturer's facility, and be ISO-9001 certified.

4. System Vendor, if other than the System Manufacturer, shall be an authorized distributor of the System Manufacturer. The distribution agreement by the manufacturer to the vendor shall be one that includes full authority to distribute, sell, certify ,program and maintain the manufacturer's complete product line whether included in this project or not. Service only, or sales only, System Vendors shall not be considered as meeting these requirements. The System Vendor shall also maintain an in-house engineering department capable and experienced in the preparation of drawings, sketches, calculations and submittals which are required as part of this contract. The System Vendor shall have successfully completed at least three installations, which have included fire alarm system work, of similar type, size and complexity as described in this Specification and the Contract Drawings. Said installations shall be in satisfactory operation for a period of not less than one (1) year, and shall have included at least one contract for the installation of a fire alarm system in an existing occupied building. The System Vendor shall also maintain an in-house technical service department staffed with at least (3) field technicians factory trained and certified by the manufacturer to install, operate, certify and maintain the system to be installed.

5. System Maintainer: For the maintenance of Fire Alarm System required in this Specification, the System Maintainer may also be the System Manufacturer, the System Vendor, or a vendor authorized and certified by the manufacturer to perform testing and maintenance services on the System installed under this Contract. The System Maintainer shall maintain an in-house technical service department staffed with at least three (3) field technicians factory trained and certified by the manufacturer to install, operate, certify and maintain the system to be installed. The System Maintainer shall be licensed and/or certified to perform fire alarm system maintenance, as required by the jurisdiction where the installed system is located. The System Maintainer shall maintain a 24 Hr. Emergency Field Service Staff, an Inventory of Parts to support the installed system and shall respond at the installed system site within 4 hours of a call for service.

B. Codes and Standard requirements

1. Conform to the requirements of NFPA 70, all applicable local codes, and all other publications referenced in paragraph 1.02 herein.

2. All fire alarm equipment, materials, devices, and assemblies used on this Contract shall be listed and/or labeled by Underwriter's Laboratories, Inc. (UL), and by other Local jurisdiction as required, for the specific purpose for which they are used. The Contractor shall not alter, install, or modify such equipment in any way so as to alter or void the listing or label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging. Protective caps shall be removed only after installation and prior to testing.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible protective coverings shall be installed to prevent equipment damage, and shall be remain in place until final testing and commissioning is completed.

E. Touch up damage to finishes to match adjacent surfaces, including re-coating of galvanized or plated surfaces where damaged, cut, or drilled.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Equipment shall be manufactured by Siemens Corporation but shall also be subject to the remainder of this Specification.

2.02 CONTROL PANEL

A. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.

B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal, and reset the panel.

C. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks, which shall plug into the system card cage. The control panel shall be capable of expansion via up to 100 SLCs. Maximum system capacity shall be at least 2500 intelligent initiation devices.

D. System Components:

1. The Device Loop Card (DLC) shall be capable of 252 intelligent devices distributed between two SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on board microprocessor provides the DLC with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following; Power, Card Failure, Network Failure, Gnd. Fault, Alarm, Trouble, Short

Zone 1, Short Zone 2, Style 6 Open Zone 1, Style 6 Open Zone 2. This card shall plug into the system card cage. The card shall be model number DLC.

2. The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.

3. The Person Machine Interface (PMI) shall provide the system information on ¼ VGA monochrome LCD, with Touch Screen and LED display. Graphic user interface shall be menu driven with 4 tabs showing the level and the total events for each tab. The tabs shall be; Alarm, Supervisory, Trouble and Security. At least 5 events shall be shown simultaneously with two full lines of text message for each event. Each event shall have a 32 character custom message describing the event's location. In addition, the time stamp and category of the event (ie. Smoke, Waterflow, Manual, etc) shall be displayed. The LED displays shall indicate Power, Audibles On or Silenced, and Partial System Disabled. Systems not having the above LED's shall provide separate LED's within the control panel enclosure with appropriate labels. Selection buttons shall be backlit to aid the operator in the selection process. There shall be controls for scrolling throughout the event list. A button shall provide zoom in zoom out for the amount of information desired for a specific entry. The PMI shall be capable of monitoring the power supply loading and show available capacity for future expansion planning. The PMI shall provide a More Info button that can display addition device information such as the device type and device address. This More Info shall also have the ability to display a detailed screen that provides the following:

   a. 200 character custom message associated with the group of the device
   b. NFPA symbols representing fire service equipment in the area
   c. NFPA symbols representing hazards in the area
   d. NFPA symbols representing people in the area
   e. Number of devices in the associated group that are in alarm
   f. Name and phone number of emergency contact

4. The Network Interface Card (NIC-C) shall provide either intranode (HNET) communication or internode (XNET) communication between enclosures. HNET and XNET communication shall support Class B Style 4 or Class A Style 7 wiring. NIC-C shall have the ability to be configured as an electrical repeater in order to increase communication distances. In addition, the NIC-C shall support CAN network communication. This card shall plug into the system card cage.

5. The Zone Indicating Card (ZIC-4A) shall contain 4 NAC circuits rated at 4 amps each with power-limited outputs. The zone inputs for the card shall be isolated and independently supervised. There shall be at least 3 unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (Such as "Recall"), and Alert (Such as "Tornado Alert"). The card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall also be listed for NFPA 13 Pre-Action Release, Halon 1301, FM200, Lease Line, and Municipal Tie. The card shall have the ability to wire the circuits Style Y or Style Z with outputs synchronized. The card shall have the following LED's to provide trouble shooting and annunciation; Power, Card Failure, Network Failure, Gnd. Fault,

Zone Activation or Trouble. This card shall plug into the system card cage. The card shall be model number ZIC-4A.

6. The Control Relay Card (CRC) shall contain 6 fully programmable relays each rated at 4A, 30VDC/120VAC resistive and 3.5A, 120VAC 0.6 PF inductive. The card shall have the following LED's to provide trouble shooting and annunciation; Power, Card Fail, HNET Fail, Relay 1 Active, Relay 2 Active, Relay 3 Active, Relay 4 Active, Relay 5 Active, Relay 6 Active. The card shall be model number CRC-6.

7. The system card cage shall provide the mounting of all system cards, field wiring, and panel's inter-card wiring. All power limited field wiring shall connect to the top of the card cage. All non-power limited internal wiring shall be connected to the bottom of the card cage. The card cage shall hold the systems cards and have capability of connecting multiple card cages to meet system demands. All terminal blocks are removable. The card cage shall be model number CC-2 or CC-5.

8. The Remote Printer Module (RPM) shall provide a means for connecting FireFinder XLS system to a serial or parallel printer for creating a hard copy of system status and configuration reports. The RPM shall also provide a Foreign System Interface (FSI) output port that can be configured to communicate with external systems, such as Building Management Systems. The RPM shall consist of two RS-232 (serial) ports and a single parallel port allowing connection to a parallel printer (such as the PAL-1). The FSI serial port shall have the ability to be configured as RS-232 or RS-485.

   a. Communication module (RS-485, Modbus TCP/IP) in unit control panel to provide capability for remote monitoring of status, parameters, and alarms identified in the Contract Documents through the SCADA system.

   b. Data system is covered in Section 16936 "Supervisory Control and Data Acquisition (SCADA) System."

9. The Switch Control Module (SCM-8) shall be a supervised module with 8 switches and two LED's per switch for controlling such items as speaker/strobe or telephone circuits. The switches shall also be used as generic inputs into the system. The SCM-8's shall be mounted in the door for easy access. These modules shall be connected to the control area network, and have a maximum distance of 1000 ft. The module shall be model number SCM-8.

10. The LED Control Module (LCM-8) shall contain eight groups of 2 LED's that shall be programmable by Zeus programming software. Eight LED's shall be dual color capable that can be lighted either RED or GREEN flashing or steady. The remaining LED's shall be AMBER flashing or steady. A space shall be provided for labeling of LED functions. The label shall slide behind a clear protective membrane. The LCM-8s shall be mounted in the door for easy access. These modules shall be connected to the control area network, and have a maximum distance of 1000 ft.

11. The Fan Control Module (FCM-6) shall provide manual control of building HVAC system fans, motors and dampers. Each FCM-6 module shall provide six sets of 3 push button switches for manual system control. Each switch shall have 3 associated LEDs to indicate Fan/Damper/Motor status: with OFF shown by a Red LED, ON shown by a Green LED and TROUBLE shown by a Yellow LED. The FCM-6's shall be mounted in the door for easy access. These modules shall be connected to the control area network, and have a maximum distance of 1000 ft.

E. System response time from alarm to output shall not exceed three (3) seconds.

F. To expedite system troubleshooting, the system cards shall have ground fault detection, and diagnostic LED's by card.

G. All system cards and modules shall have Flash memory for downloading the latest module firmware.

H. Passwords:

1. Maintenance/Control Password - There shall be a 5 character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:

   a. Arming and disarming devices.

   b. Activating, deactivating or modifying detector ASD and sensitivity settings.

   c. Activating and deactivating the History Log function, and deleting obsolete entries.

   d. Changing the system time and date.

2. Function Key Password - There shall be a 5 character password that a user must enter into the control panel in order to access the panel's Function Keys: touchscreen buttons which perform custom-programmed system functions.

3. Reports Password - There shall be a 5 character password that a user must enter into the control panel in order to access the panel's reporting functions.

4. Walktest Password - There shall be a 5 character password that a user must enter into the control panel in order to access the panel's walktesting functions.

5. Acknowledge Silenceable Reset Password - There shall be a 5 character password that a system user must enter into the control panel in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.

I. Networking:

1. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 50 remote transponders.

2. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 59 network nodes.

3. Capability shall exist within the system to extend the network at any node. The system shall support a maximum of two network extension circuits in series on any system branch, extending the inherent distance limitations for network communications.

4. Communication protocol shall be of the CSMA/CD (carrier sense, multiple access, collision detect) type, eliminating delays incorporated into other protocols. Communication techniques using token passing and requiring sensing of delays and re-generation of the token to re-establish network communications in the event of a fault shall not be acceptable.

J. Network Fiber Modules

1. Siemens model D2300CPS (multimode).

2. The network fiber interface modules shall be used to transmit RS-485 communications between the NCC, MXL and FireFinder XLS intelligent addressable

fire alarm control panels. This includes the H-Net communications between FireFinder XLS panels, M-Net communications between MXL panels and X-Net communications between FireFinder XLS, MXL and the NCC. Each module shall have power, transmit and receive status LEDs. The module can act as a repeater or end-point unit, in a daisy chain or star configuration. It shall be capable of being powered by 24VDC from the FireFinder XLS, MXL or Siemens model PAD-3 or PS-35 remote power supply. It can mount in the FireFinder XLS or MXL backbox, or can be mounted in a Siemens MBR-2 or MME-3 remote backbox. It can be located up to 5,000' from the local FACP using 1 pair #18AWG twisted/shielded cable between the fiber interface module and the FACP.

3. The connection between the D2300CPS multimode fiber interface modules shall use 2 high quality duplex 50/125 or 62.5/125 fiber optic cables and ST style fiber connectors. Each segment of the fiber network can be up to 1.9 miles. The fiber module shall have a minimum operating power output budget of -13dB for 62.5/125 cable and -9 dB for 50/125 cable. It shall be possible to connect the fiber interface modules directly to the NCC without the need for additional interface devices or control equipment.

K. Degrade Mode Alarm Activation:

1. Each data gathering panel shall support the ability to have its corresponding ZIC-4A, ZIC-8B and output devices on a DLC's loop activate when the DLC or CDC-4 is in Degrade Mode (has lost HNET communication with the PMI control panel). For example, if the device loop includes HFP detectors with relay bases and lamps, the relays and lamps shall activate upon any system alarm when the DLC is in Degrade Mode.

L. Smoke Control: The FireFinder XLS family of fire alarm panels shall have the ability to be configured as a smoke control station that complies with UL/UUKL (UL 864) and NFPA 92A requirements. The system shall have the capability to monitor and override smoke control systems and equipment provided at designated locations within the same building.

M. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.

N. NCC Interface: The fire alarm control panel shall network to the NCC via the NIC-C.

O. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from detector or manual station inputs). AND, OR, NOT, Any N, D Latch, RS Latch, Time Base Control, Start Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 1500 logic functions.

P. History: The system shall store 5000 events in history while in straight mode and 4500 in circular mode. In straight mode, trouble warnings shall occur at 4000 and 4500 events. In circular mode, the control panels shall maintain a 2000 event Alarm History buffer, which consists of the 2000 most recent alarm events from the 4500 event history file.

Q. Reports:

1. The system shall have the ability to provide configuration, status, queue and history reports.
2. Configuration reports shall provide the following information:
   a. Custom Messages
   b. Database Information
   c. Entity Type
   d. Device Usage
   e. Device Category
   f. Firmware revision
3. Status reports shall provide the following information:
   a. Disarmed cards and devices
   b. ASD settings
   c. Sensitivity in %/foot
   d. Alarm threshold in %/foot
   e. Temperature in degrees C
   f. Walktest
4. Queue reports shall provide the following information:
   a. Alarm events with custom message and event time
   b. Supervisory events with custom message and event time
   c. Security events with custom message and event time
   d. Trouble events with custom message and event time
5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:
   a. Alarm events
   b. Supervisory events
   c. Security events
   d. Status changes
   e. Alarm verification
   f. Output activation from logic
   g. System Reset
   h. Event Acknowledgements
   i. Block Acknowledgements
   j. Audible Silence System Flag Changes
   k. Sensitivity Changes
   l. Arm / Disarm Commands
   m. Arm / Disarm By Logic
   n. Manual Output Overrides
   o. Output Overrides By Logic
   p. Time Changes
   q. Menu Logins

r. ASD Changes

s. Walktest

t. Device Input to Logic Activations/Deactivations

2.03 POWER SUPPLY

A. The system Power Supply/Charger (PSC) shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. The system power supply can be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, 1 for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 120/240 VAC 50/60 Hz. The module shall be model number PSC-12 or PSX-12.

B. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with a special software package to select charging rates and battery sizes. An optional Thermistor for monitoring battery temperature to control charging rate shall be available.

C. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or down loading program information or test equipment.

D. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

2.04 SYSTEM ENCLOSURE

A. The Contractor shall provide the enclosure needed to hold all the cards and modules as specified with at least spare capacity for two cards. The enclosure outer door shall be either black or red. Color shall be provided as to the local AHJ requirements. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.

B. System enclosure shall be provided for all amplifiers. Where required by the manufacturer, means shall be provided for venting heat from the enclosure either by having enclosure sides and top vented or the doors vented.

2.05 INITIATING DEVICES

A. Intelligent Initiation Devices – General

1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections on either Style 4 or Style 6 circuits.

B. Smoke Detectors – Addressable

1. The detector shall be guaranteed in writing not to false alarm when configured by the factory trained certified technician. The detector shall provide up to 11 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.

2. The detector shall have a multicolor LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.

3. The multi-criteria smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installing and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be selected in software for a minimum of eleven environmental fire profiles unique to the devices installed location.

4. The detector shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.

5. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The outputs shall be from an input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.

6. The detector shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.

7. Detector wiring shall not require any special shielded cable. For the detector where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.

8. The smoke detector shall be model number HFP-11.

9. Where required, there shall be available a programmable remote lamp configurable to remotely duplicate the on-board LED status of another system device with the same software address. It shall be model ILED-H.

C. Heat Detectors – Addressable

1. Thermal Detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.

2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be model number HFPT-11.

D. Duct Smoke Detectors – Addressable

1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.

2. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.

3. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.

4. The intelligent duct detector shall be model number AD2-P Series. Where required there shall be available a duct housing with an on-board relay. Also where required, there shall be a standalone housing available with its own power supply and test/reset switch that does not require connection to a fire alarm control panel. It shall be model AD2-4W.

E. Detector Bases – Addressable

1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.

2. The model number for the standard base shall be DB-11.

F. Manual Pull Stations – Addressable

1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.

2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

3. The double action pull station shall be model number HMS-D.

4. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, two stage operation, reset key operation, and metal housings.

G. Addressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address shall be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model number HTRI Series.

2. Where needed a Conventional Zone Module shall connect to the Signal Line Circuit, which shall allow the use of conventional initiation devices. This module shall have the ability to support up to 15 convention smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring Linear Beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations

(model DI-3IS with ISI-1) compatible with the conventional zone module. The module shall be model HZM.

3. Single Device Damper Monitoring and Control: When connected to a FireFinder XLS system, a single HTRI switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. When connected to a FireFinder XLS system, a single HTRI-R shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.

H. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.

2.06 NOTIFICATION APPLIANCES

A. Series ZH & ZR – Strobes, Horns, Horn/Strobes

1. Audible/Visual notification appliances shall be listed for indoor use, and shall meet the requirements of FCC Part 15 - Class B
2. Appliances shall be listed under UL Standard 1971 (Standard for Safety Signaling Devices for Hearing Impaired) and UL Standard 464 (Fire Protective Signaling)
3. Appliances shall use a universal back plate, which shall allow mounting to a single-gang, double-gang, 4-inch-square, 4"-octal, or a 3-1/2"-octal backbox
4. Two-wire appliance wiring shall be capable of directly connecting to the mounting back plate
5. Continuity check shall occur for entire NAC circuit prior to attaching any audible / visual-notification appliances
6. Dust cover shall fit and protect the mounting plate
7. Dust cover shall be easily removed when the appliance is installed over-the back-plate
8. Removal of an appliance shall result in a trouble condition by the Fire Alarm Control Panel (FACP)
9. Strobe appliances shall produce a minimum flash rate of 60 flashes per minute (1 flash per second) over the Regulated Input Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan® lens
10. Strobes shall be available with two or four field-selectable settings in one unit, and shall be rated – per UL 1971 – for up to:
    a. 185cd for wall mounting
    b. 177cd for ceiling mounting
11. Strobes shall operate over an extended temperature range of 32°F to 120°F (0°C to 49°C), and be listed for maximum humidity of 95% RH
12. Strobe inputs shall be polarized for compatibility with standard reverse-polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP)
13. Audibles and Audible/Strobe Combinations
    a. Horns and horn / strobes shall be listed for Indoor use under UL Standard 464
    b. Horns shall be able to produce continuous synchronized output or a temporal code-3 synchronized output
    c. Horns shall have at least 2 sound-level settings of 90 and 95 dBA

d. Synchronization Modules

e. The strobe portion, when synchronization is required, shall be compatible with DSC sync modules, FS-250 panel, FireFinder XLS panel, or PAD-3 power supply with built-in sync protocol

14. The strobes shall not drift out of synchronization at any time during operation

15. Audibles and strobes shall be able to synchronize on a 2-wire circuit with the capability to silence the audible, if required

16. Strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. – contacts remain closed)

17. Speaker and speaker-strobe appliances shall be designed for indoor surface or flush mounting

18. All notification appliances shall be listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range"

2.07 DIGITAL COMMUNICATOR

A. The Multi-Point Digital Alarm Communicator (MDACT) shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remove Receiving Station. The MDACT shall support the following:

1. Ademco Contact ID or SIA protocol

2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual points

3. SIA selection shall provide the ability to transmit events for up to 2040 individual points

4. Programming of accounts and phone numbers

5. Dual phone line interface

6. Line fault monitoring.

7. Automatic 24-hour test

2.08 DIALER

A. The DCT-1E dialer shall be listed with the system and shall have a minimum of 4 channels. The dialer shall be mounted externally.

PART 3. EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Field verify dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

B. Arrange for the entity manufacturing the equipment to provide on-site technical supervision during installation and interconnection of the system equipment. Said supervision is to ensure the proper installation and operation of the System equipment, prior to the installed System beginning the final acceptance test.

C. After the System has been delivered, an on-site inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this section, the Contractor shall be required to replace the equipment at no additional cost to the Authority, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the System shall be installed.

3.03 INSTALLATION

A. Install all materials in accordance with the codes and standards referenced in 1.03 and in accordance with the Specifications, Contract Drawings and approved plans, shop drawings and other submittals.

B. Air duct detectors shall be installed in air handling units downstream of filters and shall be provided with a pair of sampling tubes of the length recommended by the manufacturer, for proper sensitivity and operation.

C. Wiring

1. All fire alarm cables shall be type FPLP-UL (fire alarm approved cable), twisted pair #14 gauge (unless otherwise shown on the Contract Drawings), solid copper, 200° C, 600V, shielded (or unshielded as required), insulated conductors, with FEP insulation, and conductors colored black and red. All wiring, raceways, fittings, connectors and enclosures shall be UL Listed for the intended use. Conductor terminations shall be by methods as approved by the Engineer, and as indicated on the Contract Drawings.
2. All fire alarm control and power wiring shall be in hot-dipped galvanized steel (thick wall) conduit, or as specified on the Contract Drawings.
3. Wiring for device circuits, signaling circuits, and indicating appliance circuits shall be power-limited type. System wiring shall not be mixed in raceways with other wiring. Power-limited and non-power-limited circuits shall be run in separate raceways.
4. Minimum conduit size shall be provided as required by NFPA 70, or any other local codes, using the actual cross-sectional area of the wiring to be installed. Unless otherwise noted, minimum conduit size shall be 3/4".
5. All junction boxes pull boxes, or other appurtenance which permits entry into the conduit system shall be painted red. Insulation or covering of wires and cables shall be factory color coded by use of color compounds. The color code shall be consistent throughout the performance of the work. Each pair of wires shall have a black and a red colored insulated conductor. Red shall be used for circuits with a positive (+) potential and black shall be used for circuits with a negative (-) potential.
6. All wires shall be identified with flame-retardant, low profile, labels as specified on the Contract Drawings.

D. Grounding

1. Grounding bushings shall be installed on all conduits penetrating fire alarm enclosures. The Contractor shall ground all equipment, wireways, enclosures, and circuits as shown on the Contract Drawings. Measure, record, and report shield/drain

resistance utilizing an insulation resistance test meter. Submit a copy of the original test report to the Engineer for approval.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

F. The Contractor shall provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

3.04 BOXES, ENCLOSURES AND WIRING DEVICES

A. Boxes shall be installed plumb and firmly in position.

B. Extension rings with blank covers shall be installed on junction boxes where required.

C. Junction boxes served by concealed conduit shall be flush mounted.

D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

3.05 CONDUCTORS

A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.

B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded, speaker circuits; 18 AWG twisted, telephone circuit; 18 AWG twisted shielded.

D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

F. The Contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.

G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.06 DEVICES

A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.

B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

C. All devices and appliances shall be mounted to or in an approved electrical box.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

C. Consistent color code for fire alarm system conductors shall be provided throughout the installation.

3.08 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Testing General:

1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the Contract Drawings or this Specification during testing or inspection by the acceptance inspector shall be corrected.
4. Test reports shall be delivered to the acceptance inspector as completed.
5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the Contractor. The following equipment shall be a minimum for conducting the tests:
   a. Ladders and scaffolds as required to access all installed equipment.
   b. Multi-meter for reading voltage, current and resistance.
   c. Two way radios, and flashlights.
   d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
   e. Decibel meter.
   f. In addition to the testing specified to be performed by the Contractor, the installation shall be subject to test by the acceptance inspector.

3.09 ACCEPTANCE TESTING

A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation shall be prepared by the Contractor in accordance with NFPA 72 and this specification. The Contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

B. A program matrix shall be prepared by the Contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.

C. The Contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Authority and test results recorded for use at the final acceptance test.

E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

F. Final Acceptance Test: Notify the Engineer in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test shall not be scheduled until meggar test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Engineer. Test the system in accordance with the procedures outlined in NFPA 72.

1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
4. Visually inspect all wiring.
5. Verify that all software control and data files have been entered or programmed into the FACP.
6. Verify that Shop Drawings reflecting as-built conditions are accurate.
7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:

1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
   a. Open, shorted and grounded signal line circuits.
   b. Open, shorted and grounded notification, releasing circuits.
   c. Primary power or battery disconnected.
2. System notification appliances shall be demonstrated as follows:

a. All alarm notification appliances actuate as programmed

b. Audibility and visibility at required levels.

3. System indications shall be demonstrated as follows:

a. Correct message display for each alarm input at the control display.

b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.

c. Correct history logging for all system activity.

4. System off-site reporting functions shall be demonstrated as follows:

a. Correct zone transmitted for each alarm input

b. Trouble signals received for disconnect

5. Secondary power capabilities shall be demonstrated as follows:

a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.

b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.

c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.10 DOCUMENTATION

A. System documentation shall be furnished to the Engineer and shall include but not be limited to the following:

1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.

2. System operation, installation and maintenance manuals.

3. System matrix showing interaction of all input signals with output commands.

4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.

5. System program showing system functions, controls and labeling of equipment and devices.

3.11 PROTECTION

A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

3.12 TRAINING

A. Operation and training for the system shall be a half-day seminar provided to Authority designated personnel through the means of practical demonstrations, technical literature, and other related teaching procedures unless otherwise shown on the Contract Drawings. The training shall be conducted at the construction site or location specified by the Engineer.

3.13 DEMONSTRATION

A. Instructor: Who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the Authority, in the care, adjustment, maintenance, and operation of the Fire Alarm System.

B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the Authority.

C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Authority. The instruction may be divided into two or more periods at the discretion of the Authority. One training session shall be videotaped by the Contractor. DVDs shall be delivered to the Engineer.

D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the Engineer.

E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the Authority. This session shall be separate and distinct from the above described sessions.

F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.

G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

END OF SECTION

SECTION 16721

FIRE ALARM SYSTEM EQUIPMENT

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Submit manufacturer's data for the following items. Data that describes more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Note: This submittal/shop drawing list is also incorporated within specification Section 16010/Basic Electrical Requirements.(Section 16010 is not in project spec list)

1. Manual pull stations.
2. Alarm speakers.
3. Alarm strobe appliances.
4. Alarm speaker/strobe appliances.
5. Addressable contact monitor module.
6. Addressable relay module.
7. Smoke detectors.
8. Heat detectors.
9. Wire and cable.
10. Cable/Wire Markers.
11. Graphic Display Panel.
12. Duct smoke detectors.
13. Duct detector with Remote test key and LED.
14. Booster Power Supplies.
15. Batteries.
16. Battery charger.
17. Cabinets.
18. Nameplates.
19. Backboxes and extender rings.
20. Terminal Blocks.
21. Others as required/requested by the Engineer

B. Provide detailed Shop Drawings, including, but not limited to plans, details, wiring diagrams, and riser diagram for the system provided. The riser diagram shall be complete, showing all equipment and size, type and number of all conductors, device nomenclature, and tag addresses. Drawings shall clearly show interim configurations as proposed for phased work; where required, separate drawings shall be provided for interim configurations.

C. A complete phasing plan shall be submitted outlining Overall Project Phasing as dictated by the package, to the Engineer for approval.

D. Shop Drawings shall indicate all circuit assignments as well as device addresses and device ID tags. Shop Drawing floor plans and Network Command Center (NCC) floor plans shall show fire protection zone break lines.

E. Shop Drawings shall clearly indicate where all Circuit Tee-Taps occurwith proper labeling and identification associated with junction boxes and terminal cabinets.

F. Shop Drawings shall indicate wattage taps for alarm speaker appliances. Speaker appliances shall be tapped at 1 watt, unless otherwise noted. The Contractor shall analyze individual areas and settings of speaker taps to ensure a sound level of 85 db, based on an ambient level of 70 db, is attained. Contractor shall adjust speaker taps as necessary and mark as-built drawings accordingly.

G. Shop Drawings shall outline existing power connections and sequence to existing 120V Duct Smoke Detectors outlined in this package. A System Test and Inspection of the Duct Detector Systems (Power, Data, Control circuiting) shall be performed prior to shop drawing generation and shall be borne under this contract.

H. Shop Drawings shall indicate 24 Volt power circuits necessary for system functionality. System Manufacturer shall verify the functionality and capacity of the existing circuits and reflect modifications and additions on the drawings.

I. Submit wiring diagrams and schematics showing point-to-point equipment connections and terminals used for all electrical field connections in the system.

J. Mounting details for all field devices.

K. Complete Programming Matrix equipped with Fire Protection Zone, Fire Alarm NAC Zone and Addresses, Fire Release Panel, and necessary control module information.

L. Provide a list of descriptors for each new initiating point shown on the floors plans.

M. Submit substantiating calculations showing:

1. Voltage Drop Calculations.
2. End of Line Voltage.
3. Battery capacity.
4. Supervisory power requirements.
5. Alarm power requirements.
   a. The calculations shall include the new and existing loads.(what does it mean?)

N. Upon completion of final testing, the system manufacturer shall submit record drawings detailing as-built circuiting and incorporating all field and design directives given throughout the project.

O. Provide a draft Operation & Maintenance manual for the Engineer's review and approval. Upon approval of the manual, and turnover and acceptance of the Fire Alarm and Detection System to the Authority, provide six copies of the Operation & Maintenance manuals for the Fire Alarm and Detection System. The manuals shall be bound in a ring type binder so that sheets can be inserted or removed at convenience. At a minimum, the notebooks shall be divided into the following sections and tabbed accordingly: detailed description and operating characteristics of system, maintenance requirements, maintenance checklists, list of parts and part identification numbers and supplier information, schematics, other technical information, shop drawings and catalog cuts.

P. Upon completion of this project, the Contractor shall turn over to the Authority, a copy the most current downloadable as-built fire alarm software programming. This information shall be issued as a Printed Reproducible Hard Copy. In addition, any revisions created during the warranty period shall also be issued to the Authority, in the format as described at no additional cost due to warranty related work.

END OF APPENDIX "A"

DIVISION 16

SECTION 16728

ELECTRONIC EQUIPMENT RACKS AND COMMUNICATION CABINETS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the project field and head-end equipment rack or cabinets as shown or specify on the contract drawings and documents.

B. Field Equipment Panel (FEP) shall be ground or wall mounted field equipment cabinet housing the Electronics and communication field equipments as shown or listed on the contract drawing.

C. Access Control Panel (ACP) shall be ground or wall mounted field equipment cabinet housing the Access Control System controller and accessories as shown or listed on the Contract Drawing

D. Utility rooms equipment rack (Rack) shall be 4-post/ free standing electronic equipment racks housing the communication network or the electronic system equipments as shown or listed on the Contract Drawing.

E. Utility room communication central cabinet (Central Cabinet) shall be 4 post/ free-standing communication equipment central cabinets as shown on the Contract Drawing. This cabinet shall be used for housing the PAWNET node equipment.

F. Related work specified in other sections of the Specifications includes floor-mounted and wall mounted electronic equipment in buildings and protected structures

1.02 SYSTEM DESCRIPTION

A. The Work specified in this Section shall furnish and install electronic equipment Racks, Central Cabinets, Field Equipment Panel (FEP) and Access Control Panel (ACP) enclosures, and other associated equipment designed for use in communication data centers and at outdoor bridge environment locations as required and as shown on Contract Drawings.

B. Unless otherwise specified on the Contract Drawings or in this Section, the components, manufactured, supplied and installed shall conform to the requirements of the publications referenced in this Section

C. All system equipment and components shall be submitted to the Engineer for approval.

1.03 REFERENCES

<u>American National Standards Institute (ANSI)</u>

ANSI Z 55.1	Grey Finishes for Industrial Apparatus and Equipment
	Electronic Industries Alliance / Telecommunications Industry Association (EIA/TIA)
TIA/EIA-310-D	Cabinets, Racks, Panels, and Associated Equipment
TIA/EIA-942	Telecommunications Infrastructure Standard for Data centers TIA-942
	Consumer Electronics Association
CEA-310-E	Design Requirements for Cabinets, Panels, Racks, and Sub-racks, or (latest Revised Standard)
	International Electrotechnical Commission
IEC 60297	Mechanical Structures for Electronic Equipment – Dimensions of Mechanical Structures of the 482.6mm (19 in.) Series
IEC 60297-3-100 Part 3-100	Basic Dimensions of Front panels, Sub-racks, Chassis, racks and Cabinets
IEC 60297-3-101 Part 3-101	Sub-racks and Associated Plug-in Units
IEC 60297-3-102 Part 3-102	Injector/Extractor Handle
IEC 60297-3-102 Part 3-103	Keying and Alignment Pin
IEC 60297-3-104 Part 3-104	Connector Dependent Interface Dimensions of Subracks and Plug-in Units
IEC 60297-3-105 Part 3-105	*Dimensions and Design Aspects for 1U Chassis*
	National Electrical Manufacturers Association (NEMA)
NEMA ICS 1	Industrial Control and Systems. General Requirements
NEMA ICS 1.1	Industrial Control and Systems. Safety Guidelines for the Application, Installation, and maintenance of Solid State Control
NEMA ICS 6	Industrial Control and Systems. Enclosures.
NEMA 250	Enclosures for Electrical Equipment (1000 volts Maximum)
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems
	Underwriters Laboratories
ANSI/UL 50	Cabinets and Boxes
ANSI/UL 65	Electric Wired Cabinets
ANSI/UL 486E	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
ANSI/UL 969	Marking and Labeling Systems
UL 1059	Electrical Terminal Blocks
ANSI/UL 467	Electrical Grounding and Bonding Equipment
ANSI/UL 508	Electric Industrial Control Equipment

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. All electronic equipment Racks, Central Cabinets, Field Equipment Panel (FEP) and Access Control Panels (ACP) enclosures shall be designed, manufactured, and tested in accordance with the latest revision of applicable standards of ANSI, NEMA, NFPA, and UL. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

B. Equipment designed to be placed in a rack is a rack mounted system or simply a shelf. The height of the electronic modules is also standardized as multiples of 1.75 inches or one rack unit (RU)

C. Rack and Central Cabinet shall be secured to the floor or adjacent building structure so as not to fall over. This shall conform to local building codes.

D. Rack and Central Cabinet shall have front and rear access door and they should be installed to maintain the working space for each door opening.

E. Heavy equipment, servers and deep pieces of equipment which is commonly accessed for servicing, for which attaching or detaching at all four corners simultaneously would pose a problem, shall not be mounted directly onto the rack but instead shall be mounted via rails (or slides). A pair of rails shall be mounted directly onto the rack, and the equipment shall then slide into the rack along the rails, which support it. When in place, the equipment shall also then be bolted to the rack. The rails shall also be able to fully support the equipment in a position where it has been slid clear of the Rack or Central Cabinet.

F. Should slides or rails for computers and other data processing equipment such as disk arrays or routers be required, these shall be purchased directly from the data processing equipment manufacturer, if such equipment's form factor be non-standard for rack mounting. Sliding rails shall be provided to lock in various extended positions to prevent the equipment from moving when extended out from the rack or cabinet for service.

G. To accommodate multiple computers on a single rack or Central Cabinet, KVM switch shall be furnished and installed to share a single keyboard/video/mouse set amongst the computers.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Unless otherwise shown on the Contract Drawings, Rack/Central Cabinets/ FEP/ACP panels shall meet the following environmental requirements:

1. Enclosures/Cabinets located in heated areas shall be NEMA Type 1.
2. Enclosures/Cabinets located in unheated areas or in areas subject to dust or oil, shall be NEMA Type 12 and shall maintained environment conditions required for operation of the housed equipment.
3. Enclosures/Cabinets located in exterior areas or in areas subject to rain, dripping liquid, or housing shall be NEMA Type 4X, stainless steel and shall maintained environment conditions required for operation of the housed equipment.

1.06 QUALITY ASSURANCE

A. Design Calculations

1. Heat generation and air flow calculation. This calculation shall be based on the rack, cabinet or panel equipment and proposed fan.

B. Manufacturer Qualifications

1. Not applicable

C. Fabricator Qualifications

1. Not applicable

D. Installer Qualifications

1. The Installer shall demonstrate a minimum of 1 year of continuous experience and technical expertise in performing rack and cabinet installation work comparable in size and complexity, and whose installation work was performed skillfully in a satisfactory manner and on time. The installer shall have the cabinet, rack or panel installer certification, if such offered by the manufacturer.

E. Engineer Qualifications

1. Not applicable

F. Finisher Qualifications

1. Not applicable

G. Welding Standards

1. Not applicable

H. Field Measurements

1. Not applicable

I. Mock-ups

1. The Contractor shall full assemble a FEP and ACS panel for demonstration prior installation. All panel items including the wiring, labeling, physical hardware, equipment placement, cable organizer or manager, key, terminals, electrical panel and the enclosure patch panel assembly shall be demonstrated.

J. Pre-Installation Conference

1. Not applicable

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment against damage during transit and storage. All equipment shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage during transportation.

B. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the Manufacturer, Product name, Port Authority Contract and Work Order Number (as applicable); storage requirements and any other special handling instructions.

C. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, weather, temperature, corrosion, contaminants, dirt, vandalism or other causes.

D. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-site location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment form the off-site storage facility to the Work site as well as proper storage, handling and security of the equipment at the off-site storage location.

E. After delivery at the work site, a field inspection of the equipment will be made by the Contractor in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the equipment shall be installed by the Contractor.

1.08 GUARANTEES

A. Furnish a minimum 1 year manufacturer's replacement warranty for all devices and equipment. All devices shall have a warranty against defects in materials and workmanship for a one-year period commencing on the Base Date and ending on the first anniversary of the Base Date. (Base Date is defined to be the day of Authority's acceptance of the completion of the 30-day Operational Testing specified herein).

B. The warranty shall cover all components, parts, installations, and assemblies. The warranty shall cover labor to trouble shoot, repair, reprogram, replace defective components, and travel to and from the location where the equipment resides.

1.09 MAINTENANCE

A. The Contractor shall provide the Rack, Central Cabinet, FEP or ACS panel user guide document for each installed item. The user guide document shall have description of full assemble enclosure , list of all equipment, modules and main components and maintenance the manufacturer maintenance requirement for the enclosure.

B. The Contractor shall develop the labeling plan and submitted to the Engineer for review and approval. All rack, cabinet or panel equipment and wiring shall be labeled based on the approved label plan. The labeling plan shall comply with the latest revision of ANSI-TIA-EIA-606-A: ADMINISTRATION STANDARD FOR THE COMMERCIAL TELECOMMUNICATIONS INFRASTRUCTURE

1.10 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of the following, or approved equal manufacturers:

2.02 MATERIALS

A. General

1. Electronic equipment racks and communication cabinets shall be furnished and shipped complete with all necessary fasteners, hold-down clips, power distribution units, grounding kits and connectors.
2. Location of electronic equipment racks and communication cabinets and their approximate dimensions shall be as shown on the Contract Drawings.
3. Electronic equipment racks and communication cabinets shall be assembled all components, wired, and tested on site.
4. Shipped loose components must fit and be ready for immediate installation in the field.

B. Equipment Rack

19 inch Electronic Equipment Rack

1. Manufacturer:
   a. Hoffman M8416B45 or Approved Equal
2. Dimensions:
   a. 86.13 x 24.00 x 26.25 in.
3. Minimum Rack Units (RU):
   a. 45
4. Minimum Static Load:
   a. 1500lbs.

C. Central Cabinet

Central Head-end Communication Cabinet

1. Manufacturer:
   a. Hoffman PNC2089B-MOD or Approved Equal
2. Dimensions:
   a. 78.37 x 31.80 x 34.40 in.
3. Minimum Rack Units (RU):
   a. 42
4. Minimum Static Load:

a. 1500lbs.

D. Access Control System Panel

ACS Enclosures

1. Manufacturer:

a. Type A: ACS Panel at Utility rooms and Admin Building: Hoffman A60N5212FSLP or Approved Equal

b. Type B: ACS Panel at Tower locations Hoffman A42H3612SSLP3PT or Approved Equal

2. Dimensions:

a. Type A: 60 x 52 x 12 in.

b. Type B: 42 x 36 x 12 in.

E. FEP

Field Equipment Panels for Bridge Local Area Network (BLAN) Enclosure

1. Manufacturer:

a. Hoffman PTHS482424x or Approved Equal

2. Dimensions:

a. 48 x 24 x 24 in.

2.03 CONSTRUCTION FEATURES

A. Painting on all racks and communication cabinets shall be RAL 9005 black light-textured, low-gloss.

B. Grounding points shall provide paint free metallic surfaces.

2.04 ACCESSORIES

A. Grounding Vertical Bar Kit

1. Manufacturer

a. Hoffman DG72 or Approved Equal

B. Vertical Cable and PDU Manager

1. Manufacturer

a. Hoffman PVCPM20 or Approved Equal

C. Rack / Cabinet Power Distribution Unit

1. Manufacturer

a. Hoffman PDUMNV30HV or Approved Equal

D. 2-Piece Flush-Mount Floor Brush Kit with Cover

1. Manufacturer

a. Hoffman DFB410F or Approved Equal

2.05 FABRICATION / or MIXES

A. Not Applicable

2.06 SHOP FINISHING

A. FEP and ACS full assembly are subject to Shop Finishing

2.07 SHOP TESTING

FEP and ACS full assembly are subjects for Shop Testing All FEP and ACS panel shall have 50% spare space for future expansion. If larger panel is required for spare space, the Contractor shall submit alternative size cabinet to the Engineer for review and approval.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documentation.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory Work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 PREPARATION

A. After the rack/cabinet equipment has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Specification, the Contractor will be notified in writing, and shall be required to replace the equipment at its own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

B. The Contractor shall be responsible for field verification of dimensions and locations and coordination of conduit entry and all other mounting conditions in the racks.

C. The Contractor shall provide on-site supervision during installation of the rack/cabinet equipment and accessories to be installed. Said supervision is to ensure the safety of installation and operation of the rack equipment,

3.03 INSTALLATION

A. The racks, equipment, and all necessary mounting and fastening materials to mount the racks shall be installed as required.

B. Racks and communications cabinets shall be electrically insulated from each other and from the supporting framework. Grounding and bonding of the racks shall be as specified in ANSI/UL 467 – Electrical Grounding and Bonding Equipment.

C. All communication cabinets shall be equipped with Intelligent Power Strips as per Contract Drawings.

D. All interconnecting cables, wiring, and connections to power sources and entrance racks shall be installed as shown on the approved plans, including interconnections to self-contained rack mounted equipment units.

E. Wires and cables shall be installed in a neat, workman-like manner. Wires and cables in ducts shall be laid therein and not pulled into same. Wires and cables shall be installed with a minimum amount of cross-over in the duct and shall not be pulled tightly around bends. All exposed wires and cables entering or leaving equipment racks shall be protected from abrasion and sharp edges. Slack shall be provided for each interconnecting cable or wire.

F. Field-installed wire bundles within the rack shall be harnessed in a neat manner and tied with nylon tie-wraps.

G. Where wire and cable transfers from ducts to open wiring, the ends of the duct shall be fitted to prevent damage to the wire or cable.

H. Wire and cable shall be permanently tagged by a white sleeve tag with permanent black 1/8 inch minimum lettering.

3.04 FIELD QUALITY CONTROL

A. Not Applicable

3.05 ADJUSTING (or ADJUSTING AND CLEANING)

A. Not Applicable

3.06 PROTECTING

A. Not Applicable

END OF SECTION

SECTION 16728

ELECTRONIC EQUIPMENT RACKS AND COMMUNICATION CABINETS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Bill of Materials as per the approved catalog cuts
2. Enclosure and device installation details
3. Elevation drawings which shows all racks and communication dimensions.

B. Catalog Cuts

1. 2-post and/or 4-post equipment racks
2. Communications cabinets
3. Power Distribution Units (PDU)
4. Cable Management Accessories
5. Rack / communication cabinets grounding accessories
6. Field Equipment Panel Enclosures
7. Fiber Distribution Panel Enclosures
8. Access Control Panel Enclosure
9. All other accessories required for the project

C. Samples

1. Not Applicable

D. Product Data

1. Not Applicable

E. Certificates

1. Not Applicable

F. Manufacturer Test Reports

1. Manufacturer shall provide dynamic load testing and static load testing results.

G. Construction and Installation Procedures

1. Installer shall follow manufacturer's installation instructions

H. Calculations

1. Not Applicable

I. Manuals, Warranties/Guarantees

1. *Manufacturer shall provide installation manuals for equipment within scope of this* Work.

J. Schedules

1. Not Applicable

K. Qualifications

1. Furnish the name and address of the System Installer and Integrator.

L. Quality Assurance-Quality Control

1. Not Applicable

M. Record Documents

1. Not Applicable

N. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list.

O. Inspection Reports

1. Not Applicable

P. Contact Information

1. Contractor shall submit with the Contractor Proposal, complete contact information for a single point of contact, and an alternate point of contact including: Name, Title, Address, Telephone numbers, and email address. This single point of contact shall be knowledgeable in all aspects of this equipment, and shall be available to respond to Authority queries

Q. Training

1. Not Applicable

R. Closeout Submittals

1. Not Applicable

S. Information

1. Not Applicable

T. Permits

1. Not Applicable

U. Maintenance Agreements

1. Not Applicable

V. Sustainability Submittals

1. Not Applicable

END OF APPENDIX

DIVISION 16

SECTION 16729

FIBER OPTICS CABLE

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for Single Mode and Multi Mode Fiber Optic Cable, referred to herein as SMF and MMF, Optical Fiber Connectors and Inner ducts utilized for SMF and MMF cable installations. All fibers in the cable must be usable fibers and meet required specifications.

B. This Section also specifies the fiber optic cable installation hardware including the fiber optic patch panels (FOPP), fiber optic distribution box (FODB), fiber optic patch cords, fiber optic slack enclosure (FOSE) and fiber optic splicing hardware.

C. The cable structure for cables to be used shall be completed by an application of a suitable core wrapping material, additional filling compound, a low smoke/zero halogen inner jacket, and an overall low smoke/zero halogen outer jacket.

D. The cable shall meet all requirements stated in this Specification.

1.02 SYSTEM DESCRIPTION

A. The SMF and MMF cables described in the Specification shall be used for mission-critical indoor and outdoor application. The outdoor cables will be subjected to harsh environmental conditions as experienced on a long, open and heavily used bridge carrying passenger large truck traffic

B. The FOPP shall have 12, 24, 72 or 144 bulkhead connectors, and shall be installed in the field in patch panel enclosure and in the facilities in central rack cabinets. FOPP shall have type SC connectors or other as directed by the Engineer. FOPP unit shall include all hardware components including FOPP housing enclosure, splice trays and any other ancillary equipment required for a complete, neatly assembled, and clearly labeled FOPP installation.

C. The FODB shall have 24, or 48 bulkhead connectors, and shall be expandable to 144 bulkhead connectors. FODB shall have Type NEMA 4X rated wall mounted cabinet. FODB shall be installed in the field locations adjust to the LAN field equipment panel (LAN-FEP) at the location shown on the contract drawing. FODB shall have type SC connectors or other as directed by the Engineer. FODB unit shall include all hardware components including FODB cabinet, connectors housing enclosure, splice trays, cable management hardware kits, and any other ancillary equipment required for a complete, neatly assembled, and clearly labeled FODB installation.

D. FOSE shall be furnished and installed at fiber optic cable entry locations as shown on the Contract Drawing. FOSE shall be NEMA-12 type with hinged cover and securing mechanism. FOSE shall be sized for minimum fiber optic 300' slack cables.

E. Fiber optic splicing assembly shall include all hardware, material and labors for fiber optic cables fusion splicing or pigtail splicing at the fiber termination points and splicing the hardware.

F. Fiber Optic Patch cords shall be compatible with FOPP or FODB connectors and the equipment optical connector. A patch cord shall be furnished for each connector at FOPP and FODB. The length of the patch cord shall be determined with constructed placement of the equipment and FOPP and FODB.

1.03 REFERENCES

	American Society for Testing and Materials (ASTM)
ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
	Insulated Cable Engineers Association (ICEA)
ICEA T-33-655	Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets
	International Telecommunications Union (ITU)
ITU T G.651.1	Characteristics of a 50/125 μm multimode graded index optical fibre cable for the optical access network
ITU T G.652	Characteristics of a single mode optical fiber and cable
ITU T G.653	Characteristics of a dispersion-shifted single-mode optical fiber and cable
ITU T G.654	Characteristics of a cut-off shifted single-mode optical fiber and cable
ITU T G.655	Characteristics of a non-zero dispersion-shifted single mode optical fiber and cable
ITU T G.656	Characteristics of a fiber and cable with non-zero dispersion for wideband transport
	Military Specification (MIL)
MIL-DTL-24643	Electrical Cable and Cord for Shipboard Use, Testing for Low Smoke and Halogens
	Naval Engineering Standards (British Navy) (NES)
NES 713	Determination of Toxicity Index of Products of Combustion from Small Specimens of Materials
	International Electrical Testing Association (NETA)
NETA	Acceptance Testing Specifications, Section 7.25
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Stations
NFPA 262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
NFPA 50	Standard for Road Tunnels, Bridges, and Other Limited Access

	Highways
	Rural Utilities Service (RUS)
RUS 7/CFR 1755.900	RUS Specification for Filled Fiber Optic Cables
	TELCORDIA
GR20-CORE Issue 2	Generic Requirement for Optical Fiber and Optical Fiber Cable
	Electronics Industries Alliance (EIA)/Telecommunications Industry Association (TIA)
EIA/TIA 455-3 - FOTP3	Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
EIA/TIA 455-8 - FOTP8	Measurement of Splice or Connector Loss and Reflectance Using an OTDR
EIA/TIA 455-25C - FOTP-25	Impact Testing of Optical Fiber Cables
EIA/TIA 455-26A - FOTP-26	Crush Resistance of Fiber Optic Interconnecting Devices
EIA/TIA 455-31 - FOTP31	Proof Testing Optical Fibers by Tension
EIA/TIA 455-33A - FOTP-33	Fiber Optic Cable Tensile Loading and Bending Test
EIA/TIA 455-37 - FOTP37	Low or High Temperature Bend Test for Fiber Optic Cable
EIA/TIA 455-41A - FOTP-41	Compressive Loading Resistance of Fiber Optic Cables
EIA/TIA 455-59 - FOTP59	Measurement of Fiber Point Defects Using an OTDR
EIA/TIA 455-81B - FOTP81	Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA/TIA 455-82B - FOTP-82	Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
EIA/TIA 455-85 - FOTP85	Fiber Optic Cable Twist Test
EIA/TIA 455-98A - FOTP-98	Fiber Optic Cable External Freezing Test
EIA/TIA 455-104A - FOTP-104	Fiber Optic Cable Cyclic Flexing Test
EIA/TIA 455-168 - FOTP168	Chromatic Dispersion Measurement of Multimode Graded-Index and Single-Mode Optical Fibers by Spectral Group Delay Measurement in the Time Domain
EIA/TIA 455-169 - FOTP169	Chromatic Dispersion Measurement of Single-Mode Optical Fibers by the Phase-Shift Method
EIA/TIA 455-175 - FOTP175	Chromatic Dispersion Measurement of Single-Mode Optical Fibers by the Differential Phase-Shift Method
EIA/TIA 455-176 - FOTP176	Method for Measuring Optical Fiber Cross-Sectional Geometry by Automated Grey-Scale Analysis
EIA/TIA455-178 - FOTP178	Measurement of Strip Force for Mechanically Removing Coatings from Optical Fibers

EIA/TIA 455-181 - FOTP181	Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components
EIA/TIA 455-14A OFSTP-14	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
EIA/TIA 492-AAAD	Detail Specification for 850-nm Laser-Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class la Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber
EIA/TIA 526-7 - OFSTP-7	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
EIA/TIA 568-B.1	Building Telecommunications Cabling Standard Part 1: General Requirements
EIA/TIA 568-B.3	Optical Fiber Cabling Components Standard
EIA/TIA 598-B	Optical Fiber Cable Color Coding
	Underwriters Laboratories Inc. (UTL)
UL 910	Test for Cable Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 1651	Standard for Safety for Optical Fiber Cable
UL 1666	Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1685	Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
UL 2024	Optical Fiber Cable Raceway

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. Optical fiber cables shall be furnished and installed in accordance with this Section and as indicated on the Contract Drawings.
2. The optical fiber cable installation, including all components of the optical fiber cable system, shall be manufactured and installed with the requirements of NFPA 70.
3. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.
4. The dispersion un-shifted single-mode fiber utilized in the cable specified herein shall conform to the following general, mechanical, geometrical, and performance specifications:
   a. Single mode, multiple channel, 1310 and 1550 nm for digital applications
   b. Dispersion Unshifted
   c. WDM capable

d. Environment: Outdoor

e. Application: Aerial, Direct Buried, Duct

f. Cable type: Loose Tube

g. Fiber Count: 72

h. Cladding Diameter: 125.0 ± 1 μm. Tested in accordance with FOTP-176.

i. Core Concentricity shall not exceed: = 0.6 μm.

j. Cladding Non-Circularity: = 1.0%.

k. Fiber Curl: = 4.0 m radius of curvature

l. Core Diameter: 8.2 μm typical

m. Core/Cladding Concentricity Error = 0.8μm tested in accordance with FOTP176

n. Max Attenuation Coefficient at 1310 nm = 0.5 dB/km.

o. Max Attenuation Coefficient at 1550 nm = 0.4dB/km.

p. Max Attenuation Coefficient at 1310 nm and 1550 nm for short cables such as jumper cables, indoor cables, and drop cables = 1.0dB/km.

5. The multimode fiber utilized in the cable specified herein shall conform to the following general, mechanical, geometrical, and performance specifications:

a. Multi mode, for 850nm and 1300nm digital applications

b. Cladding Diameter: 125 μm ± 2 μm.

c. Core Diameter: 50.0 μm ± 3 μm.

d. Core/Cladding Concentricity Error shall not exceed: 3 μm tested in accordance with FOTP-176.

e. Cladding Non-Circularity shall not exceed: 2.0%.

f. Core Non-Circularity shall not exceed: 6.0%

g. Max Attenuation Coefficient at 850nm = 3.5 dB/km

h. Max Attenuation Coefficient at 1300nm = 1.0dB/km.

B. Coating Dimensional Characteristics for Single Mode fiber

1. Tested in accordance with FOTP-178 (with exceptions), as indicated in GR-20 CORE Issue 2.

2. Coating Diameter: 245 ± 5 μm.

3. Colored Fiber Diameter: nominal 242 ± 7μm.

4. The coating shall be mechanically strippable with strip force: 2.0lbf (8.9 N) max, 0.3 lb-ft (1.3 N) min (Un-aged, temperature/humidity aged and water-aged as defined herein) applied to 30mm ± 3mm at fiber termination temperature extremes (0° C and 45° C).

5. The coating shall be a dual layered, UV-cured acrylate applied by the fiber manufacturer.

C. Coating Dimensional Characteristics for Multi Mode fiber

1. Tested in accordance with FOTP-178 (with exceptions), as indicated in GR-20 CORE Issue 2
2. Coating Diameter: 242 ± 5 μm
3. Colored Fiber Diameter: nominal 252 ± 6 μm
4. The coating shall be mechanically strippable with strip force: 2.0lbf (8.9 N) max, 0.3 lb-ft (1.3 N) min (Un-aged, temperature/humidity aged and water-aged as defined herein) applied to 30mm ± 3mm at fiber termination temperature extremes (0° C and 45° C).
5. The coating shall be a dual layered, UV-cured acrylate applied by the fiber manufacturer.

D. Fiber Cable Performance Standards for Single Mode Fiber and Multi Mode Fiber

1. Refer to references for performance standards for single mode and multi mode fiber optic cables.

E. Specification for Outdoor Cable Construction

1. Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 2.5 mm.
2. Each buffer tube shall contain 12 fibers.
3. The fibers shall not adhere to the inside of the buffer tube, under any conditions.
4. Manufacturer/Distributor must provide outside diameter of cable.
5. The buffer tubes shall be manufactured of high quality polypropylene allowing for enhanced flexibility and kink resistance.
6. Each fiber shall be distinguishable by means of color-coding in accordance with TIA/EIA598-A, "Optical Fiber Cable Color Coding."
7. Buffer tubes containing fibers shall be color-coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."
8. Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 1 mm.
9. For dual layer buffer tube construction cables, standard colors are used for tubes 1 through 12; stripes are used to denote tubes 13 through 24. The color sequence applies to tubes containing fibers only, and shall begin with the first tube. If fillers are required, they shall be placed in the inner layer of the cable.
10. The tube color sequence shall start from the inside layer and progress outward. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other. Colors shall not cause fibers to stick together.
11. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink back requirements as defined by RUS 7 CFR 1755.900 and GR-20CORE Issue 2.

12. Filler rods may be included in the cable core to lend symmetry to the cable cross-section when needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, fillers shall be placed in the inner layer. Fillers shall be nominally 2.5 mm in outer diameter.

13. The central anti-buckling member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to prevent buckling of the cable. The GRP rod shall be over coated with a black colored thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

14. The cable shall contain at least one ripcord under the sheath for easy sheath removal of all-dielectric cable. The ripcord color shall be orange, and be easily distinguishable from the other cable components. The ripcord must be capable of consistently splitting the cable sheath, without breaking, for 1 meter at the installation temperatures specified herein.

15. All-dielectric cables shall be jacketed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and Binder yarn. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

16. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C categories 3, 4 or 5, Grade J4. It shall contain 2.60 ± 0.25% concentration by weight of carbon black with a maximum particle size of 20nm. The carbon material shall be fully compounded into the jacket material. The jacket for cables being used in tunnel environments shall be further defined by the NFPA 262 for Flame Propagation and Smoke Density Values, which requires the jacket to be low smoke/zero halogen.

17. The jacket shall be free of holes, splits, and blisters.

18. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

19. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

20. Jacket yield strength and ultimate elongation

    a. Jacket Material

    b. Minimum Yield Strength

    c. Minimum Elongation (%)

    d. Mpa psi

    e. Type II (MDPE) Un-aged 11.0 1600 400

    f. Type II (MDPE) aged 8.3 1200 375

21. Cable jackets shall be marked with manufacturer's name, sequential meter or foot markings, month and year, or quarter and year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white; with the exception that cable jackets containing one or more co-extruded white stripes shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.

a. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 890 N (200 lbf), long term - installed.

b. The shipping and storage temperature range of the cable shall be -60°C to +85°C. The installation temperature range of the cable shall be -30°C to +60°C. Operation temperature shall be -40°C to +70°C.

22. The FOPP shall be constructed of heavy gauge aluminum and shall comply with the following requirements:

a. The FOPP shall be mounted in EIA-Standard 19-inch equipment racks. The 12 and 24-fiber panel shall not exceed 1 standard rack unit (RU) and the 72-144 fiber panel shall not exceed 5 RUs.

b. The FOPP shall use SC connectors. These connectors shall be accessible to a technician standing in front of the cabinet. Each SC connector on the panel shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm.

c. The FOPP shall route fiber optic patch cables between any two connectors without reaching the patch cables' minimum bending radius.

d. Single mode fiber used in the pigtails shall meet the optical characteristics of the cable used, including mode field diameter.

23. Connectors shall meet the TIA/EIA-568 fiber optic test procedures for single mode specifications. Test connections at the patch panel and splices made between cables to the connector with the OTDR to verify acceptable losses.

24. FODB shall include all hardware required for full termination of the FSM backbone cable including but not limited to: Connector housing, splice Tray housing, Splice Trays, connector pigtail modules, fusion splice protector, mass splicing and cable management and labeling.

25. The Splice housing shall provide a single housing for convenient pigtail splicing of fibers required. The splice housing shall be a 19-inch rack-mounted product or stand-alone module as approved by the Engineer. The housing is to be used in fiber optic cross connection applications. The splice housing shall accept up to up to four 0.2-inch-thick splice trays or two 0.4-inch-thick splice trays. The splicing housing shall have a rear and front door with a field-installable lock kit.

26. The splice trays shall be a fusion splicing tray applicable for indoor and outdoor applications. The Splice Tray shall be designed to provide fiber organization and for optimum physical protection. The size of Splice Tray shall be large enough to prevent induced attenuation due to fiber bending. The splice tray shall be a metallic casing, which should consist of a rugged aluminum base and cover. The Splice Tray shall have crimp able metal tabs to provide a strain-relief. The Splice Tray shall have organizers for a variety of popular splicing methods including mass fusion. The fusion splice organizer shall be a high-precision molded construction that holds and protects the actual splice, thereby eliminating the need for extra parts.

27. The Connector Pigtail Modules shall be designed to secure and protect various adapters within a snap-in/snap-out panel. Each module shall contain provisions for strain-relief of the pigtail. The Connector Pigtail Modules shall provide the protection to the optical cables and connectors being installed, and the optical cables being routed into the module are easier to route and store within the Connector Housing. The Connector Pigtail Module shall be factory assembled with adapters and SC connectorized pigtails installed. The Connector Pigtail Module shall have the factory-terminated cable tray with manufacture tested certifications. The Connector Pigtail Module shall have 12 fiber capacities with SC connectors.

28. Minimum one Single mode fiber optic patch cords shall be provided under each Fiber Optic Single Mode connector for completing the internal interconnections via the patch panel to all fiber optic electronics equipment as specified on the Contract Drawings. Each patch cord shall be factory terminated with SC to LC type connectors or another type approved by the Engineer.

1.05 ENVIRONMENTAL REQUIREMENTS

A. These requirements are addressed in other sub-sections of this Specification.

1.06 QUALITY ASSURANCE

A. Design Calculations

1. Not Applicable

B. Manufacturer Qualifications

1. The cable manufacturer shall be a company specializing in the manufacture of fiber optic cables and shall be ISO 9001/Q9001 certified for a Quality System for Fiber Optic Cables.

2. All optical fiber materials for which there are established UL standards shall bear the UL label.

3. Wires and cables which have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

4. Where cables specified in this Section are used to provide signal paths for systems specified in other Sections of the Specifications, or for systems shown on the Contract Drawings, review the cable characteristics provided by this Section for compatibility and use with the system equipment to be connected to the fiber optic cables.

5. Cable manufacturers shall be regularly engaged in manufacturing optical fiber cables of the types, sizes, and characteristics specified in this Section and on the Contract Drawings. Cable manufacturer's products shall have been in satisfactory use in similar service for not less than 3 years.

C. Fabricator Qualifications

1. Not Applicable

D. Installer Qualifications

1. All optical fiber cable installations, splices and terminations shall be performed by qualified workers with prior experience in installing optical fiber cables and working on optical fiber systems. Work experience shall include the successful installation of at least three other optical fiber systems of similar complexity to the work of this Section. Installer qualifications shall include successful completion of training classes covering optical fiber cable installation, termination, splicing and connectorizing.

E. Engineer Qualifications

1. Not Applicable

F. Finisher Qualifications

1. Not Applicable

G. Welding Standards

1. Not Applicable

H. Field Measurements

1. All optical fiber cable installations, splices and terminations shall be field-tested to ensure proper operations of the fiber optic system. Contractor shall devise the expected point-to-point Link Loss Budget for each fiber link in the Contract Drawings and must provide a field test report indicating and interpreting test results as described in Section 3.04 E.

I. Mock-ups

1. Not Applicable

J. Pre-Installation Conference

1. Contractor shall coordinate with The Engineer and TSD before the fiber optic system installation phase.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Each reel must be palletized on wood skid, banded through center arbor hole and attached to skid securely, and wood blocks must be placed on both sides of reel to prevent reel movement on skid.

B. The completed cable shall be packaged for shipment on non-returnable wooden reels. Required cable lengths will be stated in the purchase order. The cable reels shall be fully encased so that the cable will be protected during shipment. The covering material shall be weather-resistant and shall limit solar heating of the cable such that the surface temperature of the cable does not exceed 10°C above ambient temperatures typical for Staten Island, NY under maximum solar exposure.

C. Top and bottom ends of the cable shall be available for testing. Cable ends must be securely fastened to reels for shipping purposes.

D. Both ends of the cable shall be sealed to prevent the ingress of moisture.

E. Each reel shall be plainly and permanently marked to indicate direction it should be rolled to prevent loosening of cable on reel.

F. Each reel shall have a weather-resistant reel tag attached identifying the reel and cable. The Reel Tag Shall Include the Following Information:

1. Manufacturer Cable Number Gross Weight
2. Shipped Cable Length in Meters Job Order Number
3. Manufacturer Product Number Customer Order Number
4. Date Cable was manufactured
5. Date Cable was Tested Manufacturer Order Number
6. Cable Length Markings Manufacturer Item Number
   a. Top (inside end of cable)
   b. Bottom (outside end of cable)
   c. The Reel (One Flange) Marking Shall Include:
      (1) Manufacturer Name
      (2) Country of Origin (i.e. USA)
   d. An Arrow Indicating Proper Direction of Roll When Handling
   e. Ship to Address
   f. Ship to "Attention of" Notice (When Available)
   g. Manufacturer Cable Number
   h. Cable Length in Meters and/or Feet
   i. Gross Package Weight Inclusive of Cable, Reel, and Protective Covering
   j. Customer Purchase Order (When Available)
   k. Fork Lift Handling Illustration: "DO NOT SHIP REEL ON SIDE"

G. Each cable shall be accompanied by a cable data sheet. This datasheet must be in English, legible and packaged as described herein.

   a. The Cable Data Sheet shall as a minimum include the following information:
      (1) Manufacturer Cable Number
      (2) Manufacturer Product Number
      (3) Manufacturer Factory Order Number
      (4) PORT AUTHORITY OF NY AND NJ
      (5) The Authority Cable Number
      (6) The Authority Purchase Order Number
      (7) Ordered Length
      (8) Maximum Billable Length Actual
      (9) Shipped Length
      (10) Measured Attenuation of Each Fiber (for lengths > 1000 m)
      (11) Bandwidth Specification (where applicable)

(12) Special instructions (where applicable)

1.08 GUARANTEES

A. If within twenty five (25) years after installation date, deficiencies (latent or otherwise) are found within any of the supplied material, the Contractor shall reimburse the Authority for any costs that are incurred in correcting these deficiencies. If within twenty five years (25) years after the installation date, deficiencies (latent or otherwise) are found within any of the supplied material, the Vendor shall reimburse the Authority for any costs that are incurred in correcting these deficiencies.

1.09 MAINTENANCE

A. Arrange for cable manufacturer to provide technical support concerning the item(s) contained in this Specification at the request of the Authority.

1.10 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section provide optical fiber cables, splicing and terminating products of manufacturers Proposed for this Work.

2.02 MATERIALS

A. General

1. Locations, types, number of cables are shown on the Contract Drawings.
2. Unless otherwise shown on the Contract Drawings, cables to be installed in riser areas shall pass the flame propagation and smoke release criteria according to UL 1666.
3. Unless otherwise shown on the Contract Drawings, cables to be installed in plenum areas shall pass the flame propagation and smoke release criteria according to UL 910.
4. Unless otherwise shown on the Contract Drawings, cables classified as low smoke, low toxicity, zero-halogen (LSZH) shall meet the following:
   a. Cables shall pass the flame propagation and smoke release criteria according to the test method of UL 1685.
   b. The halogen content of the cable shall not exceed 0.2 percent according to the test method of MIL-DTL-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen" or "zero-halogen".
   c. The cable shall comply with ICEA T-33-655 for smoke generation.
   d. The toxicity index of the cable shall not exceed 2.0 according to the test method of NES 713.

e. The acid gas content of the cable shall not exceed a maximum of 2.0 percent according to the test method of MIL-DTL-24643.

5. In the event that the cable does not satisfy specifications, Contractor shall replace the cable with cable that satisfies all specifications at no additional cost to the Authority.

6. The cable jacket shall be labeled in accordance with NFPA 70.

a. The cable jackets shall be labeled using environmental resistant printing in the range of 2 foot to 4 foot intervals.

b. The label shall indicate:

(1) The cable jacketing type as per NFPA 70

(2) The number and type of optical fibers in the cable

(3) The date of manufacture

(4) The manufacturer's name and part number

B. The optical fibers shall be glass core with glass cladding. Plastic optical fibers or plastic clad silica fibers shall not be utilized, unless otherwise indicated on the Contract Drawings.

C. The optical fiber cables shall be of the following types, as indicated on the Contract Drawings:

1. Single Mode: Corning Industrial LSZH™ Loose Tube, Gel-Free, Double-Jacket Cable, 72 F, Single-mode (OS2)

2. Multi Mode: Corning ClearCurve ® OM4 Multi Mode Laser Optimized 50-um Core Diameter/125-um Cladding Diameter.

D. Cable Ratings:

1. Interior locations: Optical fiber cable installed indoors shall be listed OFNR (Optical Fiber, Nonconductive, Riser) or OFNP (Optical Fiber, Nonconductive, Plenum) in accordance with NFPA 70, as applicable, with a tight buffer construction. Cables installed in plenum areas shall be listed OFNP, in accordance with NFPA 70.

2. Outdoor locations: Optical fiber cable installed outdoors shall be gel-filled, water blocked loose tube construction. Cables shall be moisture resistant in accordance with TIA/EIA 455-82B FOTP-82. Cables shall be rated OFNG (Optical Fiber, Non-conducting, General Purpose) or OFN (Optical Fiber, Non-conducting) in accordance with NFPA 70. Cable jacketing shall be UV rated and resistant to the following chemicals:

a. Petroleum Products (gasoline, diesel fuel, lubricants, etc.)

b. Atmospheric Nitric Acid.

c. Atmospheric Sulfuric Acid

d. Carbon dioxide

e. Carbon monoxide

f. Nitrous Oxides

3. Dual rated indoor and outdoor "universal" cable: "Universal" cable shall be rated for both indoor and outdoor installations. Jacketing shall be rated OFNR/OFN for interior installations in accordance with NFPA 70 and shall also be UV rated and resistant to the chemicals listed in this Section for outdoor location cables. Cable construction shall be either tight buffer or loose tube, gel filled water blocked type.

E. *Cable Construction:*

1. The optical fibers shall be incorporated in the cable construction using either tight buffer or loose tube buffer method. The optical fibers shall be individually clad, jacketed and identified within the buffer tubes.

2. Each fiber shall be distinguishable by means of a continuous color code, continuous numbering, continuous lettering or a combination of methods. Color coding of optical fiber cables shall be in compliance with TIA/EIA–598-B.

3. Breakout type cables shall have a non-metallic strength member at the center of the cable, for the entire length of the cable.

4. Cables shall have Kevlar or Aramid yarn strength members surrounding the fiber buffering.

5. Cable Jacket:

   a. Interior: Flexible plenum rated OFNP.

   b. Outdoor: Polyethylene/Polyurethane

   c. Zero-Halogen: Cables installed in vehicular tunnels, ventilation buildings, railroad/subway tunnels and railroad stations shall be low smoke, zero halogen. PVC jacketing shall not be used in these areas in accordance with the requirements of NFPA 130 and NFPA 502.

6. Cable Jacket Color: Unless otherwise indicated on the Contract Drawings, fiber optic cable jacket shall be colored as follows:

   a. Interior Single Mode: Interior rated single-mode cables shall have a Yellow colored jacket

   b. Outdoor and Universal: Outdoor and Universal rated cables, either multi mode or single mode, shall have a black colored jacket.

   c. Fire Alarm Systems: Cables utilized exclusively for fire alarm systems shall have a red colored jacket.

7. The fiber optical characteristics and requirements shall be as indicated on the Contract Drawings.

8. Optical fiber cables shall conform to EIA FOTP-25 for impact resistance.

9. Optical fiber cables shall conform to EIA FOTP-33 for maximum pulling load.

10. Optical fiber cables shall conform to EIA FOTP-26 for crush resistance.

11. Optical fiber cables shall conform to EIA FOTP-41 for compressive load resistance.

12. Optical fiber cables shall conform to EIA FOTP-104 for flexibility.

13. Optical fiber cable installed in the vicinity of an environment subject to vibrations, including, but not limited to the Bridge, shall be able to sustain all induced vibrations without damage to the physical and optical characteristics of the optical fiber.

14. Optical fiber cable for outdoor use shall be moisture resistant as per EIA FOTP-82.

F. Optical Fiber Connectors

1. Provide optical connectors of the type indicated on the Contract Drawings capable of terminating optical fiber glass cables. Unless otherwise indicated on the Contract Drawings optical fiber connectors shall have an insertion loss of not greater than 0.75 dB.

G. Fiber Optic Innerduct

1. The Contractor shall furnish and install fiber optic innerduct of the type, characteristics and size and at the locations indicated on the Contract Drawings. The innerduct shall be corrosion resistant and unless otherwise indicated on the Contract Drawings shall be constructed of flexible polyethylene.

H. Fiber Optic Patch cord – Single Mode

1. The single mode fiber optic jumper cables shall be tight-buffer LSZH rated for indoor application as manufactured by Corning, or approved equal.

I. All materials used in the optical fiber cable shall be suitable for use under the following climatic conditions:

1. Temperature of minus 40 to plus 70 Degrees Centigrade
2. Relative humidity of 5 percent to 100 percent condensing

J. Fiber Optic Patch Panel shall be of the following types, as indicated on the Contract Drawings:

1. Rack mounted fiber optic 144 SC single mode connectors: Corning Industrial;
   a. Closet Connector Housing: CCH-04U
   b. Pigtail Splice Cassettes: CCH-CS12-59-P00RE (12 units)
   c. Size: (7 in Height x 19 in Width x 17 in Depth)
2. Rack mounted fiber optic 72 SC single mode connectors: Corning Industrial;
   a. Closet Connector Housing: CCH-03U
   b. Pigtail Splice Cassettes: CCH-CS12-59-P00RE (6 units)
   c. Size: (5.25 in Height x 19 in Width x 17 in Depth)
3. Rack mounted fiber optic 12/24 SC single mode connectors: Corning Industrial;
   a. Closet Connector Housing: CCH-01U
   b. Pigtail Splice Cassettes: CCH-CS12-59-P00RE (1or 2 units)
   c. Size: (1.75 in Height x 19 in Width x 17 in Depth)

K. Fiber Optic Distribution Box shall be of the following type, as indicated on the Contract Drawings:

1. Wall Mounted fiber optic distribution box NEMA 4X rated 24 SC single mode connectors expandable to 72 connectors: Corning Industrial;
   a. Environment Distribution Center: EDC-06P-NH

b. Pigtail Splice Trays: M67-048 (2 unit expandable to 6 units)

c. Connector Module: CCH-CP12-59-P03RH (2 module, expandable to 6 modules)

d. Size: (16.5 in Height x 14.5 in Width x 6.3 in Depth)

L. Fiber Optic Slack Enclosure shall be Hoffman A354212WFSSLP or approved equal. Minimum size shall be 36 in x 42 in x 12 in.

2.03 CONSTRUCTION FEATURES

A. Not Applicable

2.04 ACCESSORIES

A. Not Applicable

2.05 FABRICATION / or MIXES

A. Not Applicable

2.06 SHOP FINISHING

A. Not Applicable.

2.07 SHOP TESTING

A. *Factory Inspection*

1. The Authority shall have the right to inspect the manufacturer's quality control, manufacturing, and testing facilities at any time during the procurement process. Inspection by the Authority will include visual examination of the cables, and all related documentation to ensure that the cables are being fabricated in accordance with the Specifications.

B. Test Plan

1. Where required by the Contract Drawings, the Contractor shall submit a test plan for each type of cable shown on the Contract Drawings. The test plan shall be approved prior to the start of the factory test. The test plan shall include test schedule, lists of tests to be conducted, test equipment to be used, expected test results and test documents produced and copies of any certified test data to be used in lieu of testing.

2. For those tests that are not conducted during factory tests, submit to the Engineer for approval, certification by a recognized independent testing laboratory showing the complete test results. Notify the Engineer 14 days in advance of the scheduling of such factory tests.

3. Factory tests for optical fiber cable shall include, but not necessarily be limited to the following:

a. OTDR (Optical Time Domain Reflectometer) image of each fiber in both directions and in each band.

b. Bandwidth of each fiber in each band for multimode fibers

4. Documentation on the results of all factory tests and an OTDR (Optical Time Domain Reflectometer) image of each fiber shall be attached to each cable reel and a copy of this documentation shall be submitted to the Engineer for approval prior to delivery of the cable. In the event that the cable does not satisfy specifications, the Manufacturer shall replace the cable with cable that satisfies all specifications at no additional cost to the Authority.

PART 3. EXECUTION

3.01 EXAMINATION

A. Contractor shall examine all reels of delivered SMF cable to ensure cable labeling is accurate and satisfactory and identify any physical damage to the cables. Contractor shall perform in site tests of cable using OTDR. The examination and tests shall be conducted in the presence of the Engineer, and test results shall be documented and signed by all witnessing the tests.

3.02 PREPARATION

A. Examine raceways and other elements to receive cable for compliance with installation tolerances and other adverse conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 INSTALLATION / or ERECTION / or APPLICATION

A. Installing Cables:

1. Install as indicated in accordance with NFPA 70 requirements and Manufacturer's written instructions. Cable shall be installed in locations as shown on the Contract Drawings by qualified workers.

   a. During installation of the fiber optic cable the minimum bend radius of the cable, as specified by the Manufacturer, shall be observed at all times.

   b. At locations where installation of inner duct in conduits is specified in the Contract Drawings the Contractor shall pull the specified inner ducts in accordance with Manufacturer's recommended installation procedures.

B. Pulling Cables:

1. Pull cables without exceeding cable Manufacturer's recommended pulling tensions.
2. Pull cables simultaneously when more than one is being installed in same raceway.
3. Use pulling compound or lubricant where necessary; compound used must not deteriorate insulation.
4. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage media or raceway.

C. Splicing Cables:

1. Unless otherwise shown on the Contract Drawings splicing of optical fiber cable shall be permitted only when the length of the cable run exceeds those of the cable Manufacturer's pulling distance restrictions and only with the approval of the Engineer.

2. The number of splices per cable shall be kept to a minimum.

3. Splicing of optical fiber cable shall be performed by means of fusion splicing.

4. Submit to the Engineer for approval, a detailed written procedure for performing fusion splicing, prior to start of work, which shall include:

   a. The number of splices per fiber, and the location of each splice, for all optical fiber cables.

   b. The proposed means to support the splice.

   c. Covering or sheathing of splice.

5. Splicing shall be performed by qualified workers.

6. Splices shall not have losses exceeding 0.2 dB per splice.

7. All splices shall be done in the order of the fiber identification color code as per TIA 598-B and recommendations provided by the fiber optic cable Manufacturer.

8. All splices shall be enclosed in a splice organizer and then placed in a splice enclosure box. Submit catalog cuts for splice organizers and enclosures to the Engineer for approval.

3.04 FIELD QUALITY CONTROL PROGRAM

A. All tests shall be performed by the Contractor and witnessed by the Engineer. All equipment, personnel, and supervision necessary to conduct the tests shall be provided by the Contractor. All test results shall be recorded and reports delivered to the Engineer upon completion of the tests.

B. The entire installation shall be inspected for conformance to this Section and code requirements. Non conforming installations shall be corrected prior to the start of testing at no additional cost to the Authority, and reported to the Engineer.

C. Measure the actual link loss and compare it to the design loss budget and submit it to the Engineer for approval. Correct any discrepancies between the calculated and actual loss at no additional cost to the Authority and to the satisfaction of the Engineer.

D. Thirty days prior to the field test and 30 days prior to the final test specified hereinafter, submit a comprehensive testing plan to the Engineer for review and approval. The testing plan shall include test procedures for each fiber link installed between patch panels and specification of test equipment to be used. The submittal for the final test shall address any additional field tests required by the Engineer.

E. Field Test

   1. Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA Standard ATS, section 7.25. Certify compliance with test parameters and manufacturer's recommendations. The attenuation of each fiber of each cable shall be tested after the cable has been installed.

2. Field testing shall include the testing procedures approved by the Engineer, and any additional tests required by the Engineer. The testing shall include, but not be limited to, OTDR (Optical Time Domain Reflectometer) tests in both directions and in each band. Bandwidth measurements shall be conducted for multimode fiber cable. Failure of one or more fibers shall deem the installation unacceptable and the cable segment between installed splices shall be replaced at no additional cost to the Authority. No additional splices shall be introduced for the purpose of this correction.

3. Testing shall continue until all results are met to the requirements of this Section to the satisfaction of the Engineer. Data shall be presented in tabular form summarizing all OTDR test results with a comprehensible presentation of attenuation and copies of the OTDR traces shall be included as backup. An annotated sample test sheet shall be included in the test report with clear definition of all terms and results.

F. Final Test

1. Final testing shall include but not necessarily be limited to the testing procedures approved by the Engineer. Testing shall continue until all results are satisfactory to the Engineer. The test report for the installed fiber optic cable shall include: manufacturers specifications and factory test of all furnished and installed fiber optic cable and accessories, field test data of all fiber optic cable and accessories including but not necessarily limited to double ended OTDR (Optical Time Domain Reflectometer) test for all fiber links, measurement of optical power, and fiber schedule identifying the fiber strand color code, insertion loss and splice loss for each fiber. Any defects discovered and corrective measures taken shall be included in the reports.

3.05 ADJUSTING (or ADJUSTING AND CLEANING)

A. Not Applicable

3.06 PROTECTING

A. Not Applicable

END OF SECTION

SECTION 16729

FIBER OPTICS CABLE

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Bill of Materials as per the approved catalog cuts
2. Terminal block connection diagrams for all system components.
3. Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
4. Equipment Schedules and or details which define all of the equipment used within the System.

B. Catalog Cuts

1. Corning 72 F Loose Tube, Gel-free Single Mode Fiber Optic Cable
2. Corning ClearCurve ® OM4 Single Mode Fiber Optic Cable
3. Corning Single Mode Fiber Optic Jumper Cables
4. All other fiber optic system accessories required for this project.

C. Samples

1. Contractor shall supply samples of SMF to be deployed.
2. Contractor shall supply sample splice kit materials and a detailed written procedure for performing fusion splicing prior to start of work.
3. Six complete sets of the samples above to be used for training purposes.

D. Product Data

1. Contractor shall supply samples of SMF to be deployed.

E. Certificates

1. Not Applicable

F. Manufacturer Test Reports

1. As specified in section 2.07 B-3, 4.

G. Construction and Installation Procedures

1. Not Applicable

H. Calculations

1. Contractor shall provide the expected point-to-point Link Loss Budget for each link in the Contract.

I. Manuals, Warranties/Guarantees

1. Not Applicable

J. Polling Cable Plan

The contractor shall prepare the fiber optic cable installation poling plans that indicate the polling node, fiber optic cable segments and material used. The polling plan shall be approved by the Engineer.

K. Schedules

1. Within fifteen (15) calendar days after receipt by the Contractor of the acceptance of his Proposal, the Contractor shall submit to the Engineer a Project Plan and Schedule.

2. With respect to SMF cable delivery, on-spool tests, deployment and testing, the Project Plan and Schedule shall include Gantt charts, PERT charts or other tabular representations of the activities and tasks of the project as appropriate to show when tasks occur, when resources are required and what dependencies exist. The Project Plan and Schedule shall be of sufficient detail and clarity so that the Work can be controlled and the Authority can monitor progress during the life of the project. The charts shall indicate a logical sequence of Work and identify all dependencies, resources (i.e., management, technical and administrative staff), material and equipment, required for completion of the Work. The degree of detail shall be sufficient to identify at a minimum:

   a. Major Contract phases and the identification of milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.

   b. Project activities with associated tasks and sub-tasks.

   c. Interfaces and dependencies with preceding, concurrent and succeeding Work effort.

   d. Resources needed and assignments down to the task level (for staff, material and equipment).

3. In addition to the above, the Project Plan and Schedule shall contain any changes, updates or new information related to the Contractor's project organization, methodologies and standards, facilities, Quality Assurance Program or any other requirement, deliverable or features related to the performance of the SMF Cable, different from the information which the Contractor included in their Proposal.

4. Within ten (10) calendar days of receipt of the initial Project Plan and Schedule, the Engineer will formally comment on its content. The Contractor shall make appropriate changes to the Project Plan and Schedule and resubmit it for Engineer review and approval. Thereafter, the schedule shall be updated in writing at 30-day intervals.

L. Qualifications

1. As specified in Section 1.06 B.

2. Previous Project Record Submission, including:

a. Submit a list of a minimum of three installations, located in the United States, which shall have included work, comparable in type, size and complexity. Said installations shall be in satisfactory operation for the last three consecutive years, at minimum.

b. Furnish references and current contact information for each project.

c. Furnish the resumes of all key project management, integration and installation personnel.

d. Furnish certifications of training of key personnel in the integration, installation and maintenance of SMF Cable.

e. Approval of qualification information is required by the Authority prior to transmittal of any further submittals of this Section.

M. Quality Assurance-Quality Control

1. As specified in Section 1.06.

N. Record Documents

1. Not Applicable

O. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list

P. Inspection Reports

1. Not Applicable

Q. Contact Information

1. Furnish the Company name, single point of contact name, address, email and telephone number of the SMF Cable Manufacturer, Installer, Integrator and Installer.

R. Training

1. Training of the Port Authority's designated maintainers and supervisors shall be provided by the Contractor as described below.

2. All training shall be by the Contractor at location specified by the Authority and shall utilize specified manuals and documentation. All training shall be completed 14 calendar days prior to commencement of the 30 day operational test.

3. Maintainer training shall include a simulation of actual site conditions and shall be provided for groups no more than 15 per course. Each group shall be trained for one eight hour instructional classes to be held on one day. The maintenance training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

a. Splicing and patch panel tools

b. Fault tracking.

c. Fault repair.

d. Routine testing

e. Review of all topics presented in the Product Manual.

f. The Contractor shall provide Maintainer Manuals for persons attending these instructional classes and shall provide these Manuals on DVD for the Authority's use.

4. Supervisor training shall include, in addition to subjects addressed in the operator training classes, training for one group of up to six Authority supervisors. Each group shall be trained for one eight hour instructional classes to be held on one separate day. The supervisor training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

a. SMF theory and practice

b. Maintainer instruction

c. Escalation of fault repair

5. The Contractor shall videotape each type of instructional class and shall provide twelve copies of each instructional class on DVD for the Authority's use.

6. Training Report: Upon completion of all training programs, the Contractor shall prepare and deliver a training report which shall summarize the results of the full training program, including the number of training sessions conducted by type and date, the attendance sheets and the course evaluation forms for each training session.

S. Closeout Submittals

1. Not Applicable

T. Information

1. Not Applicable

U. Permits

1. Not Applicable

V. Maintenance Agreements

1. Contractor shall submit a proposed maintenance agreement.

W. Sustainability Submittals

1. Not Applicable

END OF APPENDIX "A"

DIVISION 16

SECTION 16745

DATA NETWORK EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for the Data Network equipment, including Ethernet switches, routers, and firewalls.

B. All network equipment specified herein shall be procured and purchased by the Authority (Technology Services Department).

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Data Network shall be designed using Ethernet switches, routers, and firewalls as shown on the Contract Drawings.

B. Data network equipment shall be furnished and installed in accordance with this Section and as indicated on the Contract Drawings.

C. The Data Network shall provide redundant paths for all network connections as depicted in the Contract Drawings, such that any single failure will not impact the communication system data transmission.

D. The path protection mechanisms shall be able to protect from any one of the failure types:

1. Hard link fail condition
2. Node failure
3. Degrade condition such as packet loss or CRC errors greater than a threshold.

E. The new Bridge Data Network shall be integrated into the existing Network Management System which includes the following functionalities:

1. Status of working and protecting paths.
2. Signaling of events that represent changes of status of the working and protection resources.
3. A failure event, which causes protection switch, shall trigger an alarm to be raised by the Network Management System.
4. Display list of parameters and controls relevant to the protection scheme. The parameters shall include: Hold-Off Time, Revertive/non Revertive mode and Reversion time.

F. The Data Network shall provide the necessary interfaces, resiliency and performance to support the various communications system on the networks as indicated on the Contract Drawings.

G. All communication systems running on the Data Network shall run concurrently and seamlessly. Problems in any system running on the Data Network shall not impact any of the other systems.

H. The Data Network shall provide the necessary capabilities and configurations to securely and redundantly connect to other networks as depicted on the Contract Drawings

I. Maintenance and testing functions running on the networks shall not impact the communications performance of the network.

J. The Data Network shall interface between the Bridge Data Network and the ONS PAWANET as shown on the Contract Drawings.

K. The Data Network shall have the ability to allow expansion in whole or in part, without interruption of active communication among the operational nodes. Replacement of any single node shall be transparent to the overall system operation.

L. The Data Network equipment shall be standard off-the-shelf products and shall employ route diversity to achieve multi-path physical redundancy.

M. The Data Network equipment shall be designed for full time, 24-hour, seven days a week operation.

N. When connected to any of the existing networks indicated on the Contract Drawings, the Data Network shall not degrade the performance, availability, reliability or manageability of these existing networks.

O. Networks connected to the Data Network shall not degrade the performance, availability, reliability or manageability of the Data Network.

P. The Data Network shall be designed such that equipment within the existing networks does not require upgrades to support new network protocols.

Q. In order to connect the Data Network to the existing networks indicated on the Contract Drawings, the Data Network shall conform to the existing network connection specifications by providing the necessary modules and interfaces.

R. The Data Network shall have the capability to be logically segmented into Virtual Local Area Networks (VLANs) in order to segment, or separate, traffic based on application and/or priority level such that high volume traffic applications or transient traffic does not impact or degrade other systems performance.

S. The VLAN schemes will be assigned by the Engineer and will logically segment network traffic generated from the following systems and applications:

1. Close-Circuit Television (CCTV) System,
2. Access Control System (ACS),
3. Voice over IP (VoIP),
4. Intelligent Transportation System (ITS),

5. Supervisory Control and Data Acquisition (SCADA) System.
6. Structure Health Monitoring System
7. Emergency Phone System,
8. Cisco Works SNMP Network Management System.
9. Building Management System (BMS).

T. The Uninterruptable Power Supply (UPS):

1. UPS unit shall be furnished and installed at each FEP.
2. The UPS shall be of an industrial unit rated for the operational temperature range -40 F to +130 F.
3. The UPS unit shall have a minimum nominal 1500 VA.
4. The UPS dimensions shall be finalized with dimensions of approved FEP cabinet submission.
5. UPS Communication: Ethernet RJ 45 port and RS-232 serial port.
6. Minimum battery running time (half load) is 18 minutes.

1.03 RELATED SECTIONS

A. C-Spec Section 16729 – Fiber Optic Cable

B. S-Spec Section 16127 – Control/Signal Transmission Media

1.04 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI T1.101	Synchronization Interface Standard (1999)
ANSI T1.102	Digital Hierarchy – Electrical Interfaces (1993)
ANSI T1.105.03a-1995	Supplement ANSI T1.105.03a
ANSI T1.105.03b-1997	Supplement ANSI T1.105.03b
ANSI/TIA-568-B.2-10-2008	Transmission Performance Specifications for 4-pair 100 Ω Augmented Category 6 Cabling
	Federal Communications Commission (FCC)
CFR Rules and Regulations	Title 47, Part 15
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE 802.1D	Standard for Local and Metropolitan Area Networks Media Access Control (MAC) Bridges
IEEE 802.1P	Traffic Class and Dynamic Multi-Cast Filtering Services in Bridged Local Area Networks (Draft Supplement to 802.1D)
IEEE 802.1Q	Virtual Bridged Local Area Networks

IEEE 802.1S	Virtual Bridged Local Area Networks - Amendment 3: Multiple Spanning Trees
IEEE 802.1w	Rapid Reconfiguration of Spanning Tree Protocol (RSTP)
IEEE 802.1X	Local and Metropolitan Area Networks Port-Based Network Access Control (2004)
IEEE 802.3	Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer
IEEE 802.3AB	Physical Layer Parameters and Specifications for 1000 Mb/s Operation over four pair of Category 5 Balanced Copper Cabling, Type 1000 Base-T
IEEE 802.3AC	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Frame Extensions for Virtual Bridged Local Area
IEEE 802.3AD	Standard for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Aggregation of Multiple Link Segments
IEEE 802.3AE	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications -Media Access Control (MAC) Parameters, Physical Layer and Management Parameters for 10 Gb/s Operation
IEEE 802.3AF	Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements
IEEE 802.3AH	Telecommunications and Information Exchange between Systems -- Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method
IEEE 802.3I	System Considerations for Multi-segment 10 Mb/s Baseband Networks (Section 13) - Twisted-Pair Medium Attachment Unit (MAU) and Baseband Medium, Type 10Base-T (Section 14)
IEEE 802.3u	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications: MAC Parameters, Physical Layer, Medium Attachment Units and Repeater for 100 Mb/s Operation (Version 5.0)
IEEE 802.3x	Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Specification for 802.3 Full Duplex Operation
IEEE 802.3z	Gigabyte Ethernet Standard
IEEE 802.11	Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Includes IEEE 802.11D, 802.11E, 802.11G, 802.11H, 802.11I, 802.11J

Internet Engineering Task Force (IETF)

RMON I and II Standards

SNMPv1, SNMPv2c, and SNMPv3

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 130	*Standard for Fixed Guideway Transit and Passenger Rail Systems*

Network Equipment Building (NEBS)

NEBS GR-63	NEBS Requirements: - Physical Protection
NEBS GR-1089	Electromagnetic Compatibility and Electrical Safety – Generic Criteria for Network Telecommunications Equipment

NYC Electrical Code

Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA)

TIA/EIA-310-D	Cabinets, Racks, Panels, and Associated Equipment
TIA/EIA-232-F	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
TIA/EIA-422-B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
TIA/EIA-485-A	Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems
TIA/EIA-TSB-40	Additional Transmission Specifications for UTP Connecting Hardware

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. All Data Network equipment shall be of the most highly developed technology currently available and in a state of common usage, in manufacture and performance. All equipment shall utilize standard, commercially available products. Equipment shall be modular with plug-in hardware and cabling to facilitate maintenance and expansion to the fullest extent possible. The equipment shall include necessary components and software required for a complete and operable network. All software products which are not site specific, or otherwise specified commercially available packages (such as operating systems, equipment programming and configuration software, etc.) shall be manufactured by the Data Network equipment manufacturer, as part of their standard product offering and shall not be custom produced for this application. This standard product software shall be modular in structure, enabling future system upgrades for additional capabilities to be easily accomplished, by installation of software updates without requiring modification of the existing system configuration.

1.06 QUALITY ASSURANCE

A. Qualifications

1. The Network equipment shall be furnish by the Authority (Technology Services Department). See Contract Drawing for list of the network equipment.

2. All assembly hardware, rack shelf, cable management,..., and other accessory required full full installation of the network equipment shall be furnish and install by the Contractor..

3. The Contractor shall certify that all proposed equipment shall comply completely with all the requirements of this Contract.

4. The Contractor shall retain the services of Cisco Certified Gold Channel Partner integrator for all major backbone communication system equipment components to be furnished, integrated and installed. The networking integrator shall have performed Cisco network integration for the last three consecutive years. Work experience shall include the successful installation of at least three other data networks systems of similar complexity to the Work to be performed under this Contract Credentials shall be submitted demonstrating the integrators qualifications. Qualifications shall include management, administration, configuration and testing of Cisco's Ethernet switches, routers, and firewalls. Configuration shall include Link Aggregation,, Internet Group Management Protocol (IGMP), Multicasting, VLAN, Resilient Ethernet Protocol (REP), SNMP configuration, and all other configurations required to make an optimal and operable switched and routed network. .

5. The Data Network equipment installer shall have Manufacturer's training and be certified and factory authorized in the installation of all backbone communications system equipment.

B. Quality of Materials

1. All electrical materials and equipment for which there are established UL standards shall bear the UL label.

C. The Contractor shall examine the design and specifications of all systems on the Network, in detail, and take responsibility to complete the installation and insure that all systems performance and bandwidth requirements are met.

1.07 SUBMITTALS

See Appendix "A" of this Section for Submittal Requirements.

1.08 DELIVERY, STORAGE AND HANDLING

A. Follow complete instructions and direction provided by the Engineer.

B. Deliver material in manufacturers' original unopened protective packaging.

C. Store materials in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation.

D. Handle in a manner to prevent damage to finished surfaces.

E. Where possible, maintain protective coverings until installation is complete and remove such covers as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

PART 2. PRODUCTS

2.01 MANUFACTURER

A. All Data Networking equipment shall be manufactured by Cisco Systems, (One Penn Plaza, 5th Floor Suite 510 New York, New York 10119 Phone: 212-714-4000 Fax: 212-714-4005) without substitution.

B. The Uninterruptable Power Supply (UPS) shall be SSG1.5KRM-1 manufacture by Falcon Elec. Inc or approved equal.

C. MATERIALS

D. Follow complete instructions and direction provided by the Engineer.

1. All equipment and materials furnished as work of this contract shall be new and unused. Equipment shall be of the latest technology, first grade commercial quality and shall be the standard Cisco cataloged products. Only those items specifically shown on the Contract Drawings as existing relocated or Authority furnished, if any, shall be reused. Use of rebuilt or remanufactured equipment shall not be permitted.

2. Install Cisco network equipment as specified in this section and on the Contract Drawings. If product or series is no longer manufactured or has been designated by Cisco as End of Life, then furnish the latest Cisco update or equivalent. All substitutions shall be approved by the Engineer.

E. Ethernet Switches, Routers:

1. The Ethernet switches, routers and firewalls shall be of the following types as indicated on the Contract Drawings, or in other Sections of these specifications.

   a. Cisco Industrial Ethernet PoE Cisco IE-3010-16S-8PC

   b. Cisco Industrial Ethernet Cisco IE-3010-24TC

   c. Cisco Catalyst 3750-X WS-C3750X-24P-S Series

   d. Cisco Catalyst 3750-X WS-C3750X-24T-S Series

   e. Cisco Catalyst WS-C4507R+E

   f. Cisco 1921 Integrated Services Router (VPL Router).

2. The type and quantities of Ethernet switches, routers and firewalls used will be shown on the Contract Drawings. All Ethernet switches, including those listed in this Section, along with their data specifications shall be submitted to the Engineer for approval for review of suitability for the designed application(s).

3. The Ethernet switches shall be provided for networks in support of the communications and computer systems shown on the Contract Drawings.

4. All Ethernet Switches shall be installed with the following requirements:

   a. Shall be installed in rack mountable.

   b. Shall be installed with redundant power supplies.

   c. The Contractor shall furnish and install all accessories required for full installation of the equipment..

5. All Cisco IE 3010 series switches shall be installed in compliance with Cisco requirements and recommendation and under direction of the Engineer.

F. All Cisco 3750-X series switches shall be installed in compliance with Cisco requirements and recommendation and under direction of the Engineer. All Cisco 4500 series switches/routers shall be installed in compliance with Cisco requirements and recommendation and under direction of the Engineer. Data Equipment Cabinet/Rack

1. Refer to C-Spec 16728, Electronic Equipment Rack and Communication Cabinets.

G. Cat 6 patch panels

1. Cat 6 Patch Panels shall be able to interface to multi-vendor equipment.

2. Each panel shall be equipped with a 110-type termination.

a. Cat 6 Patch Panels shall meet or exceed the EIA/TIA TSB-40 CAT6 connecting hardware specifications.

b. The Patch Panel shall be mountable in 19 inch rack units and shall accommodate top, bottom or side cable entry.

c. Patch panels shall be numbered in the front and back of each panel in a manner to give a quick and easy way to identify cable runs.

d. The patch panel for 48-port UTP terminations shall be the Tyco Electronics 48-port p/n 1375015-2, or approved equal.

e. The patch panel for 24-port UTP terminations shall be the Tyco Electronics 24-port p/n 1375014-2, or approved equal.

H. Fiber Optic Patch Panels

1. Refer to C-Spec 16729 Fiber Optics Cable.

2. The fiber optic patch panel shall be properly sized based on the number of fiber cables terminating into each equipment rack. A spare capacity of 50% shall be allowed for future growth

3. The fiber optic patch panel shall support SC duplex adapters.

I. Fiber Optic Distribution Box

1. Refer to C-Spec 16729 Fiber Optics Cable.

2. To be installed on the vicinity of LAN field equipment panels, the Fiber Distribution Box will house the fiber distribution panels for wire management on the bridge.

2.02 NETWORK MANAGEMENT SYSTEM INTEGRATION

A. For networks depicted on the Contract Drawings, provide a Network Management System (NMS) (i.e., operations, administration and management capabilities) for the Data Network.

B. The NMS shall be fully integrated by the Contractor into the Data Network.

C. The new Bridge Data Network shall be easily integrated with the existing NMS at the Goethals Bridge LAN Network.

D. The Network Management System shall monitor the performance of the end-to-end transmission across the network. The type of measurement used for performance monitoring shall include the number of packets lost, number of corrupted packets, and bit-error-rate.

E. The level of end-to-end performance monitoring provided by NMS shall allow a network administrator to determine whether the network is delivering the quality of service required by the user or application.

F. The network equipment shall time-stamp all performance monitoring reports and alarms sent to the Network Management System.

2.03 SECURITY REQUIREMENTS

A. The network shall include all the necessary security to prevent malicious users from modifying the destination of transport entities (e.g., modifying address information).

B. The network shall only allow users access to the network at the network access points based on the inclusion of the user within an access control list maintained within the management system.

C. The access control list within the management system shall indicate the allowable interfaces that a user's transport entity may be transported between.

D. The security/policy criteria (e.g., access control list) shall be configurable.

2.04 SPARE PARTS

A. The Contractor shall confirm that all system components furnished will be available from the manufacturers for a period of five years from the date of acceptance of the system by the Authority. The Contractor shall provide to the Authority spare parts to cover 10 percent of the replaceable system components.

PART 3. EXECUTION

3.01 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions, equipment quantities, equipment locations and coordination of conduit entry and all other installation conditions with the Data Network Manufacturers and the System Integrator.

B. The Contractor shall make all arrangements for a Cisco Certified Gold Channel partner integrator to provide onsite technical supervision and assistance during installation and interconnection of the system equipment. Said supervision is to ensure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

C. The Contractor shall coordinate to provide the Data Network manufacturer and System Integrator with all required information for all systems that will be utilizing the Data Network.

D. After the system equipment has been delivered, an onsite inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor shall be notified in writing, and shall be required to replace the equipment at no additional cost to the Authority, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed.

3.02 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the Work of this Section in accordance with the Contract Drawings.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory work, if any, will be needed to bring the equipment onto the site and method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where equipment are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

E. Before the Data Network Equipment installation the communication cable infrastructure shall be inspected and tested according to test plan approved by the Engineer. The results of this testing shall be reviewed by the Data Network Integrator, who shall verify its suitability for the Data Network equipment and that losses are within the equipment specs for operations. Any non conformity shall be brought to the attention of the Engineer.

3.03 FACTORY TESTS

A. A factory acceptance test for the backbone communication system shall be conducted according to test plan approved by the Engineer.

3.04 INSTALLATION

A. Procurement and configuration of all switches and routers is to be performance by the Engineer.

B. Install all network equipment in accordance with the Manufacturers' written instructions in the locations shown on the Contract Drawings.

C. All control power and data communications wire shall be wired and harnessed within the equipment enclosures as shown on the Contract Drawings.

D. All wiring shall be clearly labeled with function and wire identification number corresponding to the Manufacturer's wiring diagrams and/or approved Shop Drawings.

E. Where network connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

F. All wiring required to externally connect network equipment shall be installed by the Contractor.

G. Contractor interconnection wiring requirements shall be clearly identified on the "AS-BUILT" system drawings.

3.05 FIELD ACCEPTANCE TEST

A. Follow complete instructions and direction provided by the Engineer. .

B. After the system equipment has been installed, an onsite inspection will be made by the Engineer to verify that all wiring and Data Network equipment is installed in accordance with these specifications and the Contract Drawings.

C. The systems shall be partially installed and accepted in conjunction with construction staging. Field acceptance testing shall be conducted for each partially installed section of the network.

3.06 OPERATIONAL ACCEPTANCE TESTS:

A. The Operational Acceptance Testing phase shall commence following notification by the Authority that the results of the Field Acceptance Testing are satisfactory to the Engineer, and following receipt by the Authority of the Contractor's certification that the system is ready for Operational testing. The Operational Acceptance Tests shall be performed by the Contractor in coordination with the Authority.

B. During Operational Testing, the Contractor shall perform any re- calibration, re-configuration or re-programming of the network hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to insure that the system performs in accordance with the Specifications and required sequences of operation in accordance to teat plan approved by the Engineer.

3.07 TRAINING

A. Provide a Training Course on the Operation of the networks communication system. The Course shall consist of three days of user training for two groups of ten people each.

B. Provide a Training Course on the Maintenance of the networks communication system. The Course shall consist of three days of maintainer training for two groups of 15 people each.

C. Courses for the Data Network shall be given at the work site or at an alternate location within 20 miles radius of the Work site. Exact location to be coordinated with the Engineer.

END OF SECTION

SECTION C-16745

DATA NEWORK EQUIPMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. General Requirements:

1. Name, address and qualification data for Data Network equipment integrator as per 1.06 of this Section stating their capabilities and experience. Include proof of certifications, list of completed projects and other information specified herein.
2. Upon approval of A1 of this Appendix, submit System Block Diagrams, Catalog Cuts and functional description of proposed system features for the Data Network system and any ancillary equipment.
3. Upon approval of A2 of this Appendix, submit product data, installation manuals, materials, system configuration options and features and accessories for the Data Network. This shall include IP addresses and names as per the Port Authority conventions.
4. Upon approval of A2 of this Appendix, submit Shop Drawings. Shop Drawings shall be completely dimensioned and shall indicate the intended installation configurations and details for each Data Network Ethernet location. Shop Drawings shall include: Functional block diagrams, wiring diagrams and point-to-point wiring details.
5. A chart listing each data circuit with channel port assignment, type of channel, data circuit use or field device number, type connector, data protocol, circuit ends and IP circuit number.
6. Operation, administration, configuration and maintenance manuals.
7. As-built documents

B. Shop Drawings Requirements

1. Bill of Materials as per the approved catalog cuts
2. Terminal block connection diagrams for all system components.
3. Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
4. Equipment Schedules and or details which define all of the equipment used within the System.

C. Catalog Cuts

a. Cisco Industrial Ethernet IE-3010-16S-8PC

b. Cisco Industrial Ethernet IE-3010-24TC

c. Cisco Catalyst 3750-X WS-C3750X-24P-S Series

d. Cisco Catalyst 3750-X WS-C3750X-24T-S Series

e. Cisco Catalyst WS-C4507R+E

f. Tyco Electronics 1375015-2 Category 6 48-Port UTP Patch Panel

g. Tyco Electronics 1375014-2 Category 6 24-Port UTP Patch Panel

h. ADC/TE 24-Port Fiber Optic Patch Panel

i. ADC/TE determined 72-Position Fiber Distribution Panel

j. ADC/TE determined 48-Position Fiber Distribution Panel

k. ADC/TE determined 24-Position Fiber Distribution Panel

l. ADC/TE determined Fiber Distribution Box

m. All Accessories and physical hardwares.

D. Samples

1. Contractor shall supply samples of all materials to be deployed.

2. Contractor shall supply sample accessories and a detailed written procedure for performing unit testing prior to start of work..

3. One complete set of the samples above to be used for training purposes.

E. Product Data

1. Contractor shall supply samples of SMF to be deployed.

F. Certificates

1. As required by the equipment manufacturer for the installation work..

G. Manufacturer Test Reports

1. Certified Manufacturer's test data for all proposed equipment.

2. Test results for data network equipment upon delivery on the construction site.

H. Construction and Installation Procedures

1. To be review and approved by the Engineer.

I. Calculations

1. Optical Link Budget, Ethernet cable length, calculation shall be provided. To be review and approved by the Engineer.

J. Manuals, Warranties/Guarantees

1. Not Applicable.

K. Schedules

1. Within fifteen (15) calendar days after receipt by the Contractor of the acceptance of his Proposal, the Contractor shall submit to the Engineer a Project Plan and Schedule.

2. The Project Plan and Schedule shall include Gantt charts, PERT charts or other tabular representations of the activities and tasks of the project as appropriate to show when tasks occur, when resources are required and what dependencies exist. The Project Plan and Schedule shall be of sufficient detail and clarity so that the Work can be controlled and the Authority can monitor progress during the life of the project. The charts shall indicate a logical sequence of Work and identify all dependencies, resources (i.e., management, technical and administrative staff), material and equipment, required for completion of the Work. The degree of detail shall be sufficient to identify at a minimum:

   a. Major Contract phases and identification of milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.

   b. Project activities with associated tasks and sub-tasks.

   c. Interfaces and dependencies with preceding, concurrent and succeeding Work effort.

   d. Resources needed and assignments down to the task level (for staff, material and equipment)

3. In addition to the above, the Project Plan and Schedule shall contain any changes, updates or new information related to the Contractor's project organization, methodologies and standards, facilities, Quality Assurance Program or any other requirement, deliverable or features related to the performance of the SMF Cable, different from the information which the Contractor included in their Proposal.

4. Within ten (10) calendar days of receipt of the initial Project Plan and Schedule, the Engineer will formally comment on its content. The Contractor shall make appropriate changes to the Project Plan and Schedule and resubmit it for Engineer review and approval. Thereafter, the schedule shall be updated in writing at 30-day intervals.

L. Qualifications

1. Cable Manufacturer Qualification:

   a. The manufacturer(s) shall specialize in the manufacture of data network equipment and shall be ISO 9001/Q9001 certified for a Quality System for Electronic Equipment.

   b. All equipment for which there are established UL standards shall bear the UL label.

   c. Equipment that has been manufactured more than one year prior to delivery shall not be used in this Work.

   d. All equipment installations, connections and terminations shall be performed by qualified workers with prior experience in installing data network equipment and working on data network systems. Work experience shall include the successful installation of at least three other data network systems of similar complexity to the work of this Section. Installer qualifications shall include successful completion of manufacturer training classes covering data network equipment installation, integration, testing, and commissioning.

e. Data network equipment manufacturers shall be regularly engaged in manufacturing data network equipment of the types, sizes, and characteristics specified in this Section and on the Contract Drawings. Data network equipment manufacturer's products shall have been in satisfactory use in similar service for not less than 3 years.

2. Previous Projects

a. Submit a list of a minimum of three installations, all of which shall be located in the United States, which shall have included work, comparable in type, size and complexity. Said installations shall be in satisfactory operation for the last three consecutive years, at minimum. Furnish references and current contact information for each project.

b. Furnish references and current contact information for each project.

c. Furnish the resumes of all key project management, integration and installation personnel.

d. Furnish certifications of training of key personnel in the integration, installation and maintenance of the data network equipment.

e. Approval of qualification information is required prior to transmittal of any further submittals of this Section.

M. Quality Assurance-Quality Control

1. The Contractor shall submit the QA-QC plan to be reviewed and approved by the Engineer.

N. Record Documents

1. The Contractor shall maintain all documents.

O. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list.

P. Inspection Reports

1. Not Applicable.

Q. Contact Information

1. Furnish the Company name, single point of contact name, address, email and telephone number of the SMF Cable Manufacturer, Installer, Integrator and Installer.

R. Training

1. Training of the Port Authority's designated maintainers and supervisors shall be provided by the Contractor as follows:

a. All training shall be by the Contractor at the location specified by the Engineer and shall utilize specified manuals and documentation. All training shall be completed 14 calendar days prior to commencement of the 30 day operational test.

b. Maintainer training shall include a simulation of actual site conditions and shall be provided for groups no more than 15 per course. Each group shall be trained for two eight hour instructional classes to be held on two days. The maintenance training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

c. Installation and maintenance overview.

(1) Installation

(2) Unit tests

(3) Fault tracking.

(4) First Level fault repair.

(5) Routine testing

(6) The Contractor shall provide Maintainer Manuals for persons attending these instructional classes and shall provide these Manuals on DVD for the Authority's use

2. Operator Training Overview

a. This training shall include, in addition to subjects addressed in the installation and maintenance training classes, training for three groups of up to six. Each group shall be trained for two eight hour instructional classes to be held on two separate days. The operator training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass

(1) Using NMS to manage the data network system

(2) Fault Identification and escalation

(3) Review of all topics presented in the Product Manual.

(4) The Contractor shall provide Operator Manuals for persons attending these instructional classes and shall provide these Manuals on DVD for the Authority's use

3. Supervisor training

a. This training shall include, in addition to subjects addressed in the maintenance and operator training classes, training for two groups of up to five Authority supervisors. Each group shall be trained for two eight hour instructional classes to be held on two separate days. The supervisor training courses shall be scheduled to meet the requirements of the Authority. Training shall encompass:

(1) Data network equipment theory and practice

(2) Supervisor instruction.

(3) Escalation and resolution of fault repair

b. The Contractor shall videotape each type of instructional class and shall provide twelve copies of each instructional class on DVD for the Authority's use.

c. Training Report: Upon completion of all training programs, the Contractor shall prepare and deliver a training report which shall summarize the results of the full training program, including the number of training sessions conducted by type and date, the attendance sheets and the course evaluation forms for each training session.

S. Closeout Submittals

1. Not Applicable.

T. Information

1. Not Applicable.

U. Permits

1. Not Applicable.

V. Maintenance Agreements

1. Contractor shall submit a maintenance agreement for approval by the Authority.

W. Sustainability Submittals

1. Not Applicable.

END OF APPENDIX "A"

DIVISION 16

SECTION 16790

ROAD EMERGENCY TELEPHONE SETS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for weather resistant VOIP telephone set and accessories for emergency outdoor use on and around the bridge structure.

1.02 SYSTEM DESCRIPTION

A. The Work specified in this Section shall furnish and install wall or post mounted ring-down VOIP telephone sets and associated equipment designed for use on or around the bridge.

B. The telephone sets shall operate in harsh weather conditions and shall be audibly useable in high ambient noise environments.

C. The telephone sets shall be configured as per directions from the Engineer so as to seamlessly integrate with existing Authority VOIP switch.

D. Unless otherwise specified on the Contract Drawings or in this Section, the components, manufactured, supplied and installed shall conform to the requirements of the standards referenced in this Section. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

E. All telephone sets, equipment and components proposed shall be submitted to the Engineer for approval.

1.03 REFERENCES

Call Set-Up Protocol

SIP (RFC 3261) Only

MIL SPEC

MIL-HDBK-217F Notice 2 MTBF Calculations

FCC Rules Part 15

ITU-

TP37 Tested to ETS 300-381

ITU-T k.21 Lightning/Transient Protection

Radio and telecommunications terminal equipment (R&TTE)

Harmonized standards under Directive 1999/5/EC

International Electrotechnical Commission

IEC 60529: Degrees of protection provided by enclosures (IP Code).International Electrotechnical Commission, Geneva.

CISCO Product Compatibility Testing.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. All telephone sets shall be designed, manufactured, and tested in accordance with the latest revision of the applicable References.

B. Equipment shall be designed for wall mounting or for pole mounting. Pole mounting shall also mean mounting to a bridge steel structural member. The sets shall be ruggedized and weather resistant as they are to be employed occasionally by bridge users, usually in distress situations subject to high ambient noise.

C. Sets will employ a handset which is connected to the base set by a conductor protected within a flexible metal sheath.

D. Telephone handsets shall be secured to a structure so as not be moved. Movement of the set shall initiate an alarm.

E. Ring down VOIP technology shall be employed so as to initiate an immediate voice call to a designated operator upon the handset going "Off Hook".

F. The telephone set shall have no external moving parts or keypad buttons, and shall be protected by a weather resistant auto-closing spring-loaded door.

G. The telephone sets shall be powered by PoE compliant to IEEE 802.3af

1.05 ENVIRONMENTAL REQUIREMENTS

A. Door Open- IP 65; Door Closed- IP66

B. Operating temperatures -20° C to +60° C

1.06 QUALITY ASSURANCE

A. Design Calculations.

1. Not applicable.

B. Manufacturer Qualifications

1. Not applicable

C. Fabricator Qualifications

1. Not applicable

D. Installer Qualifications

1. The Installer shall demonstrate a minimum of 1 year of continuous experience and technical expertise in performing outdoor weather resistant telephone set installation work comparable in size and complexity, and whose installation work was performed skillfully in a satisfactory manner and on time.

E. Engineer Qualifications.

1. Not applicable

F. Finisher Qualifications

1. Not applicable

G. Welding Standards

1. Not applicable

H. Field Measurements

1. Not applicable

I. Mock-ups

1. Not applicable

J. Pre-Installation Conference

1. Not applicable

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment against damage during transit and storage. All equipment shall be secured to prevent distortion or other damage during transportation.

B. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the Manufacturer, Product name, Port Authority Contract and Work Order Number (as applicable); storage requirements and any other special handling instructions.

C. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, weather, temperature, corrosion, contaminants, dirt, vandalism or other causes.

D. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-site location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment form the off-site storage facility to the Work site as well as proper storage, handling and security of the equipment at the off-site storage location.

E. After delivery at the work site, a field inspection of the equipment will be made by the Contractor in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the equipment shall be installed by the Contractor.

1.08 GUARANTEES

A. Furnish a minimum 1 year manufacturer's replacement warranty for all devices and equipment. All devices shall have a warranty against defects in materials and workmanship for a one-year period commencing on the Base Date and ending on the first anniversary of the Base Date. (Base Date is defined to be the day of Authority's acceptance of the completion of the 30-day Operational Testing).

B. The warranty shall cover all components, parts, installations, and assemblies. The warranty shall cover labor to trouble shoot, repair, reprogram, replace defective components, and travel to and from the location where the equipment resides.

1.09 MAINTENANCE

A. Contractor shall present detailed maintenance procedures to be followed by maintenance staff.

1.10 SUBMITTALS

A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products of the following, or approved equal.

2.02 MATERIALS

A. General

1. Telephone sets shall be furnished and shipped complete with all necessary accessories.
2. Telephone sets shall be connected and unit tested in situ.
3. Location of telephone sets and their dimensions shall be as shown on the Contract Drawings.

B. Telephone Set

1. Manufacturer:
   a. Gai-Tronics or Approved Equal
2. Model Titan VOIP Ring Down # 110-02-1010-222
3. Dimensions:
   a. 7.44 W 14.4 H 5.11 D in.
4. Functional Requirements:
   a. Embedded Browser for simple configuration
   b. Vandal Resistant Handset and Cord
   c. Robust and weather resistant up to IP66
   d. Full keypad, full keypad with memory, ringdown and 1, 3 and 6 button autodial versions
   e. Multi purpose design for wall or post mounting, simple installation
   f. Large tactile buttons, easy to see and operate
   g. Four contact inputs, and two relay outputs as standard
   h. E-mail fault reporting

2.03 CONSTRUCTION FEATURES

A. Mounting details including conduit connection to the phone box and wiring to be provided.

2.04 ACCESSORIES

A. GGai-Tronics : 12509-028 CMA (Call Management Application)

2.05 FABRICATION / or MIXES

A. Not Applicable

2.06 SHOP FINISHING

A. Not Applicable

2.07 SHOP TESTING

A. Not Applicable

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documentation.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory Work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where telephone sets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before installing the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

E. Verify the equipment is compatible for integration to the existing Cisco VIP and full operation testing of the phone system.

3.02 PREPARATION

A. After the telephone set equipment has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Specification, the Contractor will be notified in writing, and shall be required to replace the equipment at its own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

B. The Contractor shall be responsible for field verification of dimensions and locations and coordination of conduit entry and all other mounting conditions.

C. The Contractor shall provide on-site supervision during installation of the telephone set equipment and accessories to be installed. Said supervision is to ensure the proper installation and operation of the equipment,

3.03 INSTALLATION

A. The telephone sets and all necessary mounting and fastening materials to mount the sets shall be installed as required.

B. All interconnecting conduits and cables shall be installed as shown on the approved plans, in accordance with manufacturer's instructions.

C. Conduits and cables shall be installed in a neat, workman-like manner. All conduit/cables entries shall be suitably weatherproofed in accordance with manufacturers' instructions. Conduits to the sets shall be securely fastened to supporting members with no slack.

D. Telephone sets shall be tagged as per Engineers' instruction.

3.04 FIELD QUALITY CONTROL

A. Not Applicable

3.05 ADJUSTING (or ADJUSTING AND CLEANING)

A. Not Applicable

3.06 PROTECTING

A. Not Applicable

END OF SECTION

SECTION 16790

ROAD EMERGENCY TELEPHONE SETS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings
   1. Bill of Materials as per the approved catalog cuts
   2. Enclosure and device installation details
   3. Elevation drawings which shall show all telephone set dimensions.

B. Catalog Cuts
   1. Ring-down VOIP Weather-Resistant Telephone Set
   2. Communications cabinets
   3. Cable Management Accessories
   4. Rack / communication cabinets grounding accessories
   5. All other accessories required for the project

C. Samples
   1. Three samples of the proposed telephone sets shall be provided.

D. Product Data
   1. Detailed technical description and electronic block diagram.

E. Certificates
   1. Provide FCC Part 15 Certification.

F. Manufacturer Test Reports
   1. Manufacturer shall provide testing and test results.

G. Construction and Installation Procedures
   1. Installer shall follow manufacturer's installation instructions

H. Calculations
   1. Not Applicable

I. Manuals, Warranties/Guarantees
   1. Manufacturer shall provide complete installation manuals for proposed equipment in hard and soft copy.

J. Schedules
   1. Not Applicable

K. Qualifications
   1. Furnish the name and address of the System Installer.

L. Quality Assurance-Quality Control

1. Not Applicable

M. Record Documents

1. Not Applicable

N. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list.

O. Inspection Reports

1. Not Applicable

P. Contact Information

1. Contractor shall submit with the Contractor Proposal, complete contact information for a single point of contact, and an alternate point of contact including: Name, Title, Address, Telephone numbers, and email address. This single point of contact shall be knowledgeable in all aspects of this equipment, and shall be available to respond to Authority queries

Q. Training

1. Not Applicable

R. Closeout Submittals

1. Not Applicable

S. Information

1. Not Applicable

T. Permits

1. Not Applicable

U. Maintenance Agreements

1. Not Applicable

V. Sustainability Submittals

1. Not Applicable

END OF APPENDIX "A"

DIVISION 16

SECTION 16792

INTELLIGENT TRANSPORTATION SYSTEM

PART 1. GENERAL

1.01 SUMMARY

This Section describes the electrical, electronics, and communications requirements and work related to Intelligent Transportation Systems (ITS) infrastructure hereafter referred to as the "System".

The Contractor shall furnish and install a complete turn-key System that includes all required electrical components for each ITS component. The System components include all electrical items specified in this Section including Closed Circuit Television (CCTV) Cameras for Traffic Monitoring, Road Weather Information System, Dynamic Message Signs, Vehicle Detection System, TRANSCOMSM (Transportation Operations Coordinating Committee) – TRANSMITTM (TRANSCOM's System for Managing Incidents & Traffic) receivers, Variable Speed Limit Signs, all related computer peripherals and software. Client workstations and servers will be furnished by the Authority and installed by the Contractor. ITS sub-components consisting of electrical panel boards, power supplies and auxiliary equipment, enclosures, conduits, pull boxes, junction boxes, mounting hardware, cabling, switches, lights, and related items shall be furnished and installed on various structures as described on the Contract Drawings.

The Contractor shall furnish and install ITS elements necessary to fulfill the requirements and functionality of the System.

1.02 RELATED SECTIONS

07270	Fire stopping
13710	Video Surveillance System - Cameras
16000	Electrical General Requirements
16110	Raceways
16114	Cable Trays
16115	Underground Conduit Systems
16120	Wires, Cables, Splices, Terminations (600 Volts or Less)
16127	Control/Signal Transmission Media
16128	Arc proofing
16133	Control Panels, Enclosures/Cabinets, and Terminal Boxes
16135	Boxes and Fittings
16140	Wiring Devices
16190	Supporting Devices
16250	Transfer Switches
16320	Dry Type Transformers, General Purpose (600 Volts or less)
16450	Grounding
16452	Bonding

16470	Panel boards
16475	Overcurrent Protective Devices (600 Volts or less)
16729	Fiber Optic Cable
16745	Data Network Equipment

1.03 REFERENCES

Telecommunications Industry Association (TIA) / Electronic Components Industry Association (ECIA)

232 – Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

310 D – Cabinets, Rack, Panels and Associated Equipment

422/485 – Electrical Characteristics of Balanced Voltage Digital Interface Circuits

568 – Commercial Building Telecommunications Cabling Standard

569 – Commercial Building Standard for Telecommunication Pathways and Spaces

607 – Commercial Building Grounding and Bonding Requirements for Telecommunications

National Fire Protection Association (NFPA)-

70 - National Electrical Code

New York City Building Code (NYCBC)-

New York City Electrical Code (NYCEC)

Institute of Electrical and Electronics Engineers (IEEE)

C62.41 – Guide for Surge Voltages in Low Voltage AC Power Circuits

802.3at – Data terminal equipment (DTE) power via the media dependent interface (MDI) enhancements

802.3af – Data terminal equipment (DTE) power via the media dependent interface (MDI) enhancements

802.1X – Port based network access control

International Electrotechnical Commission (IEC)

60529 – Degrees of protection provided by enclosures (IP Code)

62262 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

Internet Protocol (IP)-IPv4/v6 - Internet Protocol (IP) Version 4, Version 6

Port Authority of NY & NJ

Agency CCTV Standards v5.1

Standards & Guidelines for Port Authority Technology v8.3

Guide to System Administration v5.1

Video Coding Experts Group (VCEG)-H.264 - Advanced Video Coding (AVC)

National Electrical Manufacturers Association (NEMA)-

4X - ICS 6: Industrial Control and Systems Enclosures

Electronic Code of Federal Regulations (E-CFR)-

47CFR68 – Connection of Terminal Equipment to the Telephone Network

American Public Transportation Association

APTA SS-SIS-RP-002-08 Recommended Practice for CCTV Camera Coverage and Field of View Criteria for Passenger Facilities

1.04 SCOPE

A. The Work specified under this Section includes the following ITS devices that are to be furnished, installed, tested, and made operational:

Furnished and Installed Quantity	ITS Component
16	Closed Circuit Television System Cameras (CCTV)
5	Daktronics 2329 Dynamic Message Sign (DMS)
2	Daktronics 2320 Dynamic Message Sign (DMS)
7	Variable Speed Limit Sign (VSLS)
96	In Pavement Vehicle Detectors (IPVD)
8	Vehicle Detector Wireless Access Points
3	Road Weather Information System (RWIS) Remote Terminal Unit
2	TRANSCOM SM – TRANSMIT TM Readers (see below)
15	ITS Cabinets- Various Types (See Contract Drawing T0719 for details)
3	Uninterruptable Power Supplies (UPS)
	All necessary Connections to Power, IP and Fiber Optic Communications Systems for proper operation.

B. Provide assistance with provisioning of CCTV cameras onto the Verint software application as directed by the Engineer. This includes camera MAC addresses and the installation of Cisco network IP switches and routers. The Work also includes camera mounting brackets, power transformers, power and communication cabling, communication equipment and other items and appurtenances required to provide working systems for various structure-mounted CCTV configurations.

C. All IP networking, server and workstation equipment will be furnished by the Authority and shall be installed by the Contractor.

D. TRANSMIT TM readers, antennas and RF modules will be furnished by the Authority and shall be installed by the Contractor.

E. The Contractor shall de-commission the (nearby) existing TRANSMIT sites that are being replaced upon commissioning of the Contractor installed sites.

F. TRANSCOM will provide technical consultation for and final review of the installation of travel time tag-reader equipment and will perform the configuration of and integration of that equipment into TRANSCOM's TRANSMIT travel time system at no cost to the Contractor. Coordinate work with Ken Francis, Senior ITS Specialist of TRANSCOM at (201) 963-4033 (ext. 522). Provide construction schedules and updates to TRANSCOM, as approved by the engineer. Contact TRANSCOM 14 days in advance if on-site services are required.

G. Furnish, install, test, and make operational all wireless road embedded vehicle detection sensors and wireless access points.

H. Furnish and install all ITS Cabinets as specified in Part 2.

I. Furnish and install: UPS at each of the three (3) main ITS gantries, Authority provided networking equipment, AC power panels, and fiber cable distribution panels as defined on the Contract Drawings and in Part 2. The ITS Cabinet shall be pre-assembled and tested in each gantry at ground level before final erection of ITS gantries. Power and communication cables shall be run within separate legs of the assembled structure.

J. Coordinate with TRANSCOM to provide start-up and testing of TRANSMIT equipment installed as part of the work of the Contract. Perform testing as directed by the Engineer.

K. Program the Daktronics Sign server software for all message scenarios defined on the Contract Drawings.

L. Where multiple units of the same type are required, all shall be identical and manufactured by the same manufacturer.

M. Exposed conduit shall be PVC coated galvanized steel that meets the requirements stated in Section 16110 Raceways.

1.05 SYSTEM DESCRIPTION

A. The Bayonne Bridge ITS consists of the following ITS components:

1. Dynamic Message Signs (DMS)
2. Dynamic message signs and variable speed limit signs shall be installed on ITS Gantries and overhead structures. System software to operate the signs shall be installed on server equipment furnished by the Port Authority and installed by the Contractor.
3. Variable Speed Limit signs (VSLS)
4. Variable speed limit signs shall be installed on ITS Gantries and other structures.
5. CCTV Cameras
6. CCTV Camera System shall be outdoor environmental approved day/night PTZ color CCTV *dome camera system with optical zoom, outdoor pendant enclosure with a clear bubble, and* standard CAT-6 Ethernet communications.
7. Road-Weather Information Systems (RWIS)
8. The RWIS shall include of the following weather condition sensors, further described on Contract Drawing T0718:
   a. Remote roadway surface state sensors.
   b. Air temperature sensors.
   c. Air humidity sensors.
   d. Wind direction and speed sensors.
   e. Remote Terminal Units (RTU)
9. Vehicle Detection

   Magnetic wireless sensors installed in the roadway shall be furnished, installed, tested and made operational to monitor and collect traffic parameters that include volume, occupancy and speed. Wireless Access Points that receive and accumulate this data shall be installed at points as shown in the Contract Drawings T0703 to T0715. These locations include ITS Gantries and other structures above the roadway.
10. TRANSCOM^{SM} - TRANSMIT^{TM} Overhead Traffic sensors

    Hardware for this system shall be furnished by Authority and installed by the Contractor to monitor travel times between detection points depicted on Contract Drawings T0707 and T0711.

1.06 QUALITY ASSURANCE

A. Contractor Qualifications

The Contractor performing the Work of this Section shall demonstrate to the satisfaction of the Engineer a minimum of five (5) years experience and technical expertise in performing contracts

comparable in size and complexity, and that the Work was performed skillfully in an on time and satisfactory manner. The entity shall submit a complete list, which shall consist of a minimum of three (3) installations, all of which shall be located in the United States and shall have included work, comparable in type, size, and complexity to the Work of this Contract. Said installations shall be in satisfactory operation for the last three (3) consecutive years, minimum.

B. The Contractor shall schedule and conduct a Pre-Installation Conference to review and coordinate the work as described herein.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space, protected from weather.

C. Handle materials in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final clean-up.

E. Touch up damage to finishes to match adjacent surfaces, including recoating of galvanized or plated surfaces where damaged, cut, or drilled.

F. Costs of all shipping to the site and of all unusual storage requirements shall be borne by the Contractor. It shall be the responsibility of the Contractor to make appropriate arrangements and to coordinate with authorized personnel at the site for the proper acceptance, handling, protection, and storage of equipment so delivered.

G. Movement of material, either at the time of delivery or subsequently, shall be the sole responsibility of the Contractor. All costs associated with this movement shall also be the responsibility of the Contractor.

H. The Contractor shall be responsible for the safe storage of all equipment. In the event of equipment disappearance from the site, the Contractor shall bear full responsibility and all costs associated with equipment replacement at no additional cost to the Authority.

1.08 MAINTENANCE

A. Owner's Manual/Maintenance Instructions

B. Spare Parts and extra materials

1.09 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. DESIGN AND PERFORMANCE REQUIREMENTS

The Contractor shall furnish, install, and test the following ITS System Components and appurtenances:

2.01 CCTV CAMERAS

A. PTZ CCTV Camera System for Traffic Monitoring

Camera Requirements - See Contract Documents Section 13710

The camera shall be dome/pendant type. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system. All system and components shall have been thoroughly tested and proven in actual use.

1. Technical Specifications
   a. Pan-Tilt-Zoom (PTZ) IP Network Camera:
   b. Image sensor: ¼" Ex View HAD progressive scan CCD
   c. Lens: f=3.4 – 119 mm, F1.4 – 4.2, autofocus, automatic day/night Horizontal angle of view: 55.8° - 1.7°
   d. Minimum illumination: Color: 0.5 lux at 30 IRE F1.4 B/W: 0.008 lux at 30 IRE F1.4
   e. Shutter time: 1/30000 s to 0.5 s (60 Hz), 1/30000 s to 1.5 s (50 Hz) Pan/tilt/zoom: E-flip, 100 preset positions Pan: 360° endless, 0.05° – 450°/s Tilt: 220°, 0.05° – 450°/s 35x optical zoom and 12x digital zoom, total 420x zoom
   f. Pan/tilt/zoom functionalities: Guard tour, Control queue, On-screen directional indicator.
   g. Video compression: H.264 (MPEG-4 Part 10/AVC), Motion JPEG
   h. Resolutions: D1 720x480 to 176x120 (60 Hz)
   i. Frame rate H.264: H.264: Up to 30 fps (60 Hz) in all resolutions, Motion JPEG: Up to 30 fps (60 Hz) in all resolutions
   j. Video streaming: Multiple, individually configurable streams in H.264 and Motion JPEG Controllable frame rate and bandwidth
   k. VBR/CBR H.264
   l. Image settings: Wide dynamic range (WDR), electronic image stabilization (EIS), compression, color, brightness, sharpness, white balance, exposure control, exposure zones, backlight compensation, fine tuning of behavior at low light, rotation, aspect ratio correction, text and image overlay, 32 individual 3D privacy masks, image freeze on PTZ
   m. Security: Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
   n. Supported protocols: IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, FTP,CIFS/SMB, SMTP, SNMPv1/v2c/v3 (MIB-II),DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP,DHCP, ARP, SOCKS
   o. Application Programming Interface: Open API for software integration
   p. Event triggers: Intelligent video, external input, PTZ preset, temperature
   q. Event actions: File upload: FTP, HTTP, network share and email Notification: email, HTTP and TCP External output activation, video recording to edge storage, PTZ preset, guard tour Pre- and post-alarm video buffering.
   r. Casing: IP66- and NEMA 4X-rated metal casing (aluminum), acrylic (PMMA) clear dome, sunshield (PC/ASA)
   s. Memory: 128 MB RAM, 128 MB Flash
   t. Power Capability: Separate low Voltage power supply
   u. Connectors: RJ-45 for 10BASE-T/100BASE-TX
   v. Edge storage: SD/SDHC memory card slot (card not included); support for recording to network share (network-attached storage or fileserver)
   w. Operating conditions: -40 °C to 50 °C (-40 °F to 122 °F) Arctic Temperature Control enables camera start-up at temperatures as low as -40 °C (-40 °F) Humidity 10 - 100% RH (condensing)
2. Power and Communications Cables
   a. The camera system shall be provided with all power and communications cables as shown, specified or recommended by the manufacturer.

b. All cables shall be UL listed for intended use and suitable for installation in outdoor environment. Power cable shall provide 24 VAC power to camera from the Remote Power Unit.

c. The communications cables shall establish communications between the camera and the associated IP router. Cable shall be equipped with connectors and length shall be as specified, shown or approved.

3. CCTV Remote Power Unit

a. The Contractor shall design, furnish, and install a CCTV Remote Power Unit consisting of a complete assembly comprised of a weatherproof enclosure with a low Voltage power supply, PTZ terminal blocks, Ethernet camera video terminal block, fuses, and other components as supplied by the manufacturer. The Remote Power Unit shall be provided with all required mounting hardware in order to provide attachment. The power units shall meet or exceed all camera environmental requirements.

b. The CCTV Remote Power Unit shall be a manufacturer recommended Outdoor Power Supply Box, or approved equal, with required mounting hardware.

2.02 FIBER TERMINATION PANELS

A. The Contractor shall design, furnish, and install Fiber Termination Panels (FTP), in each enclosure in accordance with this Specification and the ITS Contract Drawings T0701 to T0731. The panel shall be a compact rack mountable unit for interconnectivity and termination of optical fibers that meets or exceeds the following general requirements:

B. General Requirements:

Dimensions:	6.30"H x 5.50"Wx1.57"D
Panels:	One (1) Adapter Panel
Fiber Capacity:	Minimum of Six (6) Single Splice Holders
Material:	Minimum of 18 Gauge Steel
Coating:	Electrostatic polyester powder coat paint.

The FTP shall be as manufactured by Multilink, Inc. part number FWM-1X-SP; Corning Cable Systems, Inc. part number ICH-02P or approved equal.

Each fiber termination panel shell shall be provided with 6 simplex single mode SC connector ports.

All stainless steel hardware shall be Type 304 in accordance with ASTM A193 Grade B8.

2.03 ROAD WEATHER INFORMATION SYSTEM (RWIS)

A. The Contractor shall furnish and install Vaisala (no substitutions permitted) RWIS stations as shown in the Contract Drawings. The RWIS equipment shall include the following components, features and requirements:

1. Remote Terminal Unit (RTU) furnished with all required interconnections, power supply and enclosures.
(Qty. 3- VAISALA 70130200)

2. Remote Road Surface State and Temperature Sensors
(Qty. 6- VAISALA DSC111 and Qty. 6-DST111 Non-Intrusive Pavement Sensor- NIPS with Non-Remote Pole Installation Kits)

3. Communications Interface
(Qty. 3- VAISALA CDMA Modem Kit 59030315)

4. In addition, the RTU for equipment to be installed near the top of the Bridge Arch shall include all of the above and the following:
5. Ultrasonic Wind Sensor, Heated Accessory Kit, Connection Cable
   (Qty. 1- VAISALA WMT700 2B2A0A003B1A2)
6. Ambient Air Temperature/Humidity Sensor, Accessory Kit, Radiation Shield, Connection Cable
   (Qty. 1- VAISALA HMP155 E1AA11A0A2A1A0A)
7. Precipitation/Visibility Atmospheric Sensors
   (Qty. 1- VAISALA PWD12, Connection Cable, Installation Kit)
8. Pressure Sensor PTB110 and PTB110 LX-RPU NA Accessory Kit
   (Qty. 1- VAISALA PTB110.1A0AB)

B. The following services shall be arranged to be provided by VAISALA:

1. VAISALA System Set Up
2. VAISALA Software Set-Up
3. VAISALA Data Management (paid by Contractor - until acceptance)
4. VAISALA Commissioning
5. VAISALA Annual pre-season Maintenance during warranty period
6. VAISALA On-Site Training (2 days for up to 5 persons)
7. VAISALA Required System Engineering Work
8. VAISALA Warranty- 5 years
9. VAISALA Qty. 5 LX Technical Manuals and 5 CD copies.
10. VAISALA Qty. 5 DSC111/DST111 Roadway System Installation Manuals
11. VAISALA Shipment of all equipment to site

C. The following charges shall be paid by Contractor:

D. Verizon Cellular charges (paid by Contractor- until acceptance)

E. The Contractor shall design, furnish, mount install and make operational the atmospheric sensors, the RTU, and other equipment and related cabling. Included is all work necessary to install sensors a minimum of 30 feet from the travel lane, where possible, to assure proper operation of atmospheric sensors. All weather sensors shall be furnished by Vaisala (no substitutions allowed) and shall operate in conjunction with other currently installed Vaisala RWIS equipment and software.

1. Remote Terminal Unit

   The RTU shall be a Vaisala LX-RPU no substitutions permitted. The Contractor shall design, furnish, and install a remote terminal unit to collect and store data from the atmospheric sensors and pavement sensors and be able to interpret that data in order to predict and alert system users of existing or impending dangerous conditions such as; ice, black-ice, frost, freezing rain or snow. The RTU supplied shall be part of a standard product line and not custom or specially produced for this Contract. The RTU shall include a RWS-LX Panel Assembly with a microprocessor of current manufacture that is capable of performing all of the required functions.

   The RTU shall be supplied with a host serial port for interfacing to a laptop computer to perform diagnostic and calibration functions. The RTU shall have the capability for future expansion of the number of serial ports, analog I/O ports, and digital I/O ports.

2. Atmospheric Sensors

Sensors shall measure the parameters listed below:

Air Temperature
Air Humidity
Precipitation Detector (rain or snowfall intensity)
Wind Speed
Wind Direction
Barometric Pressure
Visibility

Atmospheric Sensors shall be mounted near the top of the arch per manufacturer's recommendations.

3. Remote Road Surface State Sensor–Non-Intrusive Pavement Sensor (NIPS)

   Passive pavement sensors are defined as surface sensors that measure the physical properties of the pavement surface, including moisture on the pavement surface, temperature on the pavement surface, and ice melting point. The Pavement sensors shall be furnished and installed at each RTU in ITS Gantries and on the bridge structure and be aimed at the NIPS target area depicted on the Contract Drawings. Each Non-Intrusive Pavement Sensor shall be Vaisala DSC111 and a Vaisala DST111 remote temperature sensor. Separate NIPS units shall be furnished, installed and aligned for measurement of roadway conditions at each target depicted on the Drawings.

   Sensors shall be installed in accordance with the manufacturer's instructions and guidelines. Sensor control cable and power cable from the RTU shall be routed within a conduit system that shall protect the wiring. Conduit and all fittings, connections, elbows, and mounting hardware shall conform to Port Authority's Specification and all NEC requirements.

4. Power Supply

   The Contractor shall furnish, and install each RTU to operate from 120 VAC input power and furnish and install all necessary connecting conduits, wires, cables and appurtenances to connect to power from the ITS cabinet shown in Contract Drawings T0707, T0709 and T0711 to render proper operation, as determined by the Engineer.

5. Communications Interface

   The Contractor shall design, furnish, and install each RWIS RTU station with a Cellular Communications Kit utilizing Verizon service to supply data to the Vaisala server. The equipment furnished and installed under this Contract shall operate in conjunction with the existing Vaisala RWIS terminal and software.

2.04 VARIABLE MESSAGE SIGNS (VMS)

A. The Contractor shall acquire, furnish, install, and test Variable message Signs as described in the Contract Documents. The Variable Message signs shall be sole sourced from Daktronics, no substitutions permitted.

B. The following products types shall be furnished, installed, and made operational at locations shown on the Contract Plans:

   1. VF-2329-96x336-20-RGB
   2. VF-2320-64x192-20-RGB

C. Performance Requirements

   1. VMS shall be legible during day and night time for distances of 1000 feet or more. To be visible across multiple lanes, VMS must accommodate viewing angles of 15 to 17 degrees. All LED signs shall conform to MUTCD.

2. Photocell control shall be provided to control the brightness level of LEDs by dynamically changing the illumination intensity of LEDs corresponding to changes in sunlight. This reduces "blooming" of displays at night and glare during the day. A minimum of three photocell sensors are required. Two sensors shall be placed to sense the light levels striking the front and rear of each sign. A third photocell sensor shall be placed to measure overall ambient light. Sensors shall be located on the sign case such that access and maintenance are readily accomplished. The sensors shall be designed in a manner that allows for field adjustment to offset existing point light sources that may affect the legibility of the VMS.

D. Other VMS characteristics shall include:

1. Legibility distance using 18" characters: a minimum 1000 feet
2. Cone of Vision: at least 30 degrees (minimum)
3. 100,000-hour MTBF for LEDs under continuous operation of a current of approximately 20mA, where a failure is defined as light output degradation of more than 50 percent.
4. Each character shall be comprised of 10 x 14 set of pixels for standard fonts on a line-matrix VMS.
5. Sign housing, framing and structure shall be designed for wind-loading criteria in accordance with AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

E. Electrical Requirements

Power requirements for VMS components are shown on Contract Drawing T0716.

F. Environmental Requirements

1. VMS shall contain a thermostatically controlled defogging system designed to remove and prevent condensation on the inside of the display. VMS shall also provide a means to exhaust the air from inside the enclosure for cooling purposes.
2. VMS and controller equipment shall be designed to operate without degradation between –22 F and +158 F, and a relative humidity of 0 to 95%.

G. Physical Requirements

1. VMS controller equipment and ancillary equipment shall be 19" rack mountable in a NEMA 3R enclosure and shall not exceed 51" high by 25" wide by 16" deep.
2. Field equipment shall be contained in secure cabinets that conform to Port Authority standards with locking mechanisms and tamper switches. The cabinets shall use tamper switches to monitor when the cabinet is opened and closed. An alarm signal shall be returned to the central host computer, and subsequently reported to the system operator when the cabinet door is opened and again when the door is closed.

H. Communication Interfaces/Bandwidth Requirements

VMS require a minor amount of communication bandwidth; approximately 9.6kbps. Sign controllers typically store pre-approved programmed messages on site, while still allowing for custom messages to be downloaded as needed. More often the communications link needs only select which message is to be displayed. These signs shall be polled for operational and security status. This polling rate shall be at least once a minute. A pair of fibers shall be used to transmit bi-directional data, containing operational status and message displayed, back to the Communications Desk.

I. System Control Requirements

1. System control for the proposed VMS shall be administered from the Goethals Bridge Operations Room (GBOR). The variable message signs shall be compliant with the adopted NTCIP VMS standard protocol. Bi-directional communications are required in order to provide feedback from each VMS as commands/messages are sent from the central system Graphical User Interface (GUI). VMS elements shall provide for the ability to store messages locally as well as accept messages generated by operators at the GBOR using the GUI. Individual messages shall be programmed for each VMS as shown on Contract Drawings T0729 through T0731. Automatic control scenarios are for Contractor reference only and are included in the Contract Drawings as T0720 and T0721. Automation of the scenarios will be included in a separate Core Software Contract.

2. **Controllers:** Internal (within sign enclosure) and external Aux Control Panel (Mounted in the sign control cabinet on ITS Gantry or at roadway level) for all VSLS. External VFC 3000 controllers mounted in the nearby sign control ITS cabinet as shown in Contract Drawings T0723 and T0724.

2.05 VARIABLE SPEED LIMIT SIGNS (VSLS)

A. The Contractor shall acquire, furnish, install, and test Variable message Signs as described in the Contract Drawings. The Variable Message signs shall be sole sourced from Daktronics, no substitutions permitted.

B. The following VSLS product shall be furnished, installed, and made operational at locations shown on the Contract Plans:

Daktronics VS-5220-2-18-W-VSLS

1. Performance Requirements
   a. VSLS shall be legible during day and night time for distances of 1000 feet or more. To be visible across multiple lanes, VSLS must accommodate viewing angles of up to 30 degrees. The LED signs shall conform to MUTCD.
   b. Brightness shall be controlled both automatically using a built-in light sensor and manually from a remote location (such as the GBOR).
   c. Other VSLS characteristics shall include:
      (1) Sign Face Panel Dimensions: 5'0" high x 4'0" wide
      (2) Speed Limit Text: Black lettering on white background in conformance with MUTCD
      (3) Variable Speed Digits: Black digits on white (full-color) LED background
      (4) Display Face: Louvered Open Face Full Matrix
      (5) Sign viewing Angle: 30 degrees minimum
      (6) Digit Size: 18"
      (7) Digit Capacity: 2
      (8) Active Area:1'9" height x 2'8" width
      (9) Pixel Matrix:16 rows x 24 columns minimum
      (10) Color Capability: Full-color (white)
      (11) Controllers: Internal (within sign cabinet) and external Aux Control Panel (Mounted in the ITS Cabinet in the ITS Gantry or a separate enclosure at roadway level).
      (12) Cabinet Environmental Rating: Internal – NEMA 3R
      (13) Power: 197 Watts Maximum; 145 Typical
2. Environmental Requirements

VSLS shall be designed to operate in temperatures ranging from minus 25 degrees to 140 degrees Fahrenheit and in a humidity range between 0 and 99 percent non-condensing.

2.06 VEHICLE DETECTION SYSTEM

The Vehicle Detection System shall meet or exceed the following requirements:

A. General

1. The work shall consist of furnishing, installing, configuring, and testing a wireless, battery-powered magnetometer Vehicle Detection Station system consisting of in-pavement wireless sensors, Wireless Access Points (WAP), and miscellaneous electronic equipment for monitoring vehicle parameters at appropriate locations. The system shall use in-pavement wireless magnetic sensors to detect the occupancy, speed and presence of vehicles. The in-pavement sensors shall be wireless, transmitting their detection data in real-time via low-power radio technology to a nearby access point, mounted on a lighting standard, that then relays the data to one or more local or remote traffic management controllers and systems.
2. The system shall be an integrated hardware and software solution that functions over an IP-based network protocol as manufactured by Sensys Networks, Inc. of Berkeley, California, no substitutions permitted. The Vehicle Detection System (VDS) shall include all equipment and devices installed under this Contract which when combined make-up the vehicle detection system. This includes, but is not limited to, Wireless Access Points, In-Pavement Wireless Sensors, power injectors, surge protectors, media converters, network cables, computer software and services required for software configuration and system testing.

B. Vehicle Detection System Software and Common Equipment

1. Vehicle volume (count) per lane over a specified time interval.
2. Lane occupancy (percent) over a specified time interval
3. Vehicle speed (mph or kph)
4. Per-vehicle speed
5. Median speed over a specified time interval
6. Mean speed over a specified time interval
7. Distribution of speeds over a specified time interval, with a resolution of 1 mph/ 2 kph
8. Vehicle classification
9. Per-vehicle length
10. Distribution of speeds over a specified time interval, with a resolution of 1 foot/ 0.5 meters
11. The time interval for measurements shall be selectable, including at least the following intervals:
    - 30 seconds
    - 1 minute
    - 5 minutes
    - 15 minutes
    - 1 hour
    - 24 hours

12. The various vehicle detection system components shall communicate using low-power radio technology to send time-stamped detection event data. All communications between the roadway sensors and nearby access points shall be without any lead-in cabling or other wires. The radios employed by the system shall operate in the globally available 2.4 GHz unlicensed frequency band and shall be based on the IEEE 802.15.4 PHY industry standard. As defined by the 802.15.4 PHY standard, the wireless detection system shall operate on 16 defined channels in the 2.4 GHz band. The specific choice of the frequency channel shall be determined and configured by the manufacturer's representative based on local conditions and the requirements of the installation.

13. Data for each event shall be sent as it occurs, or as many as 16 events shall be buffered at the sensor and transmitted at a fixed reporting interval or whenever the buffer is nearly full (synchronized reporting).

14. Sensor firmware shall be remotely upgradeable by transmission from the access point without requiring removal or local intervention. Access Point firmware shall be remotely upgradeable by transmission from the central computer without requiring removal or local intervention. The detection system shall have the ability to individually turn off polling to spare or failed sensors in order to minimize polling time and maximize sensor battery life. The IP addresses for the access points shall be provided by the Port Authority for configuration by the Contractor.

15. The communication subsystem of the wireless battery-powered magnetometer vehicle detection system shall further conform to the manufacturer's protocol, or an approved equal.

16. The wireless access point shall communicate the data received from the wireless sensors to the network switch in the ITS Cabinet through an outdoor rated network cable from the access point to the power injector and from the power injector to the network switch.

C. Vehicle Sensor Wireless Access Point

1. The vehicle sensor Wireless Access Point shall serve as a communication hub for the in-pavement wireless sensors. A wireless access point shall be able to support a minimum of 48 sensors. An access point shall be factory-configured to support powering from a Power-Over-Ethernet Power Injector with 110VAC input. Maximum power consumption of the wireless access point shall be 2 Watts.

2. The wireless access point shall operate at temperatures from –37° F (-38.3° C) to +176° F (+80° C). All components of the wireless access point shall be contained in a single housing. The housing shall conform to NEMA Type 4X and IEC IP67 standards and shall be no larger than 12" H x 8" W x 4" D.

3. The wireless access point shall consist of a Sensys Networks AP240-E Access Point or approved equal. The access point shall have a host processor consisting of 66 MHz Coldfire processor, 4 MB of flash memory, and 16 MB of DRAM. The Ethernet interface shall have the following characteristics:

   - 10/100 BaseT
   - IP address via DHCP or static
   - IP67 RJ45 bulkhead connector
   - Proprietary Power Over Ethernet (12V to 24V)
   - Standard Power Over Ethernet (36V to 60V)

4. The access point shall be capable of TCP/IP support as follows:

   - Protocols supported: telnet, ftp, http, PPP, PPTP
   - Tunneling to VPN shall allow a connection to the access point without a static address

- Encryption over Tunnel

D. In-Pavement Wireless Sensors

1. The in-pavement wireless sensor shall detect vehicles by measuring changes in the earth's magnetic field near the sensor as caused by a stopped or passing vehicle. The sensor shall sample the earth's magnetic field at a rate of 128 Hz. The sensor shall communicate time-stamped ON and OFF vehicle detection events. As an option, the sensor shall provide a mode where the complete X-Y-Z magnetic signatures of detected vehicles are transmitted as data. Each sensor shall automatically recalibrate in the event of a detector lock.
2. The wireless sensor shall have dimensions of 2.9-inch length, 2.9-inch width, and 1.9-inch height. It shall conform to the following RF specifications:
   - IEEE 802.15.4 Standard Compliant
   - Operate in any one of 16 MHz channels in the 2.4 – 2.48 GHz ISM band
   - All sensor components shall be contained within a single housing. The sensor housing shall conform to NEMA Type 6P and IEC IP68 standards. The sensor components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The sensor housing shall be capable of being installed in a 4-inch diameter hole approximately 2 ¼ inches deep. It shall operate at temperatures from –37o F (-38.3o C) to +176o F (+80o C). The wireless sensors shall be battery-operated with an average lifetime of ten (10) years when the sensor is configured for and operating under normal traffic conditions.
   - The in-pavement wireless sensors shall be battery powered and have an expected battery lifetime of 10 years.
   - The in-pavement wireless sensor shall be a Sensys Networks VSN240-f Wireless Sensor.

E. Power Injector

1. The power injector shall have the following features:
   - Lightning and surge protection on data and power lines
   - Industrial grade cast aluminum housing
   - Shielded RJ-45 jacks EMI noise suppression
   - RoHS Compliant (Individual Injector)
2. The power injector shall be in compliance with the following specifications:
   a. Electrical Specifications

Operating Temperature (Injector):	-40° C to +70° C
Operating Temp - Power Supply:	0° C to +50° C
Maximum Current:	1 A
Power Connector:	Standard 2.5mm Coaxial DC Power Jack (2.5mm x 5.5mm x 10mm Center Positive Plug Required)
Ethernet Connectors:	(2) RJ45 Jack
Data Lines:	Pair 1: Pins 1 and 2 Pair 2: Pins 3 and 6
CAT-5e Power Pinouts:	+ VDC: Pins 4 & 5 - VDC: Pins 7 & 8

b. Mechanical Specifications

Weight:	.28 lbs. (.13 kg)
Dimensions:	3.6 x 1.4 x 1.2 (inches)
Enclosure:	Cast Aluminum Alloy
RoHS Compliant:	Yes (Injector only)

The power injector shall be a commercial grade Power-over-Ethernet (PoE) device that provides DC power for one PoE-equipped device. It shall be compatible with access points and other equipment supporting the IEEE standard PoE pinout (Pins 4 & 5 Power + / Pins 7 & 8 Power -).

The power injector shall have shielded RJ45 jacks. This along with the unit's metal housing shall help reduce the effects of EMI interference. A ground lug and terminal shall be provided directly on the injector housing providing superior grounding and shall be grounded.

The power injector shall be model BT-CAT5-P1-4848 as manufactured by Hyperlink Technologies or approved equal.

F. Epoxy

1. The epoxy shall be a two (2) part, self-leveling, 100% solid polyurea-based epoxy that can be applied at temperatures ranging from 20° F to 180° F.

2. The epoxy shall have the following physical properties, depending on the volume ratio:

Specification	Standard	Volume Ratio 2: 1	Volume Ratio 1:1
Tensile Strength	ASTM D412	2950	1500
Elongation (%)	ASTM D412	350	800
100% Modulus	ASTM D412	1620	1400
Tear Strength (PLI)	ASTM D412	500	450
Hardness (Shore A)	ASTM D2240	95A	85A
Flexibility (1/8" Mandrel)	ASTM D1737	PASS	PASS
Flashpoint (°F)	ASTM	>200	>200

3. The epoxy shall be manufactured by Fabick, 3M or approved equal. The epoxy shall be applied using the appropriate tools and applicators as recommended by the manufacturer.

G. Media Converter

(1) The media converter shall have the following characteristics:

- 10/100Base -TX to 100Base-FX Conversion
- Comply with NEMA TS1 & TS2 Environmental requirements
- Single Mode SC fiber optic terminations
- Hardened aluminum case
- Supports DIN-Rail, Panel or Rack Mounting

(2) The media converter shall be in compliance with the following specifications:

(a.) Electrical Specifications

Operating Temperature:	-40° C to +75° C
Input Voltage:	10 to 48VDC
Maximum Current:	3 A @ 12V
Power Connector:	Terminal Block or Power Jack
Ethernet Connectors:	(1) RJ45 Jack

Fiber Connectors:	Single Mode SC
Nominal Wavelength:	1310nm
Cable Type:	Single Mode
Optical Budget:	15 dB
Packet Buffer Memory:	768K bits
Latency:	Less than 128.9µs

(b.) Mechanical Specifications

Weight:	1.76 lbs.
Dimensions:	1.97x4.33x5.35 (inches)
Enclosure:	Aluminum

The Media Converter shall be as manufactured by EtherWAN, ComNET Communication Networks, or approved equal.

2.07 TRANSCOM-TRANSMIT

A. TRANSMIT Reader Sites

Two (2) TRANSMIT Reader sites shall be installed as shown in the Contract Drawings. Each Reader location shall be provided with 15-Ampere 120-Volt AC electrical service.

A single antenna shall be utilized to cover two (2) lanes of traffic in each direction at each TRANSMIT Reader location. Each of the two (2) antennas shall be mounted directly above the lane dividing line, at 10 degrees +/- 5 degrees from horizontal.

Each Reader location shall include all TRANSCOM required hardware consisting of: Kapsch reader hardware, Kapsch antennas, lane kits, cables, cabinet and all associated connections and equipment needed to collect vehicular data and communicate with the remote server presently installed at TRANSCOM's facility. The Contractor shall arrange to obtain the required Kapsch site equipment (Reader hardware, antennas, lane kits) from the Engineer and install the reader hardware in an APX 1-150-001763 or approved equal enclosure. The Contractor shall furnish and install antenna cable. This cable shall be Andrew FSJ4-50B (or approved equivalent) with all outdoor connections weatherproofed. Andrew (or approved equivalent) Type N connectors shall be applied to each end of the antenna cable. Antennas shall be mounted on a custom bracket shown on Contract Drawing S2748 and installed to TRANSCOM's requirements and as described above. The Contractor shall furnish and install at each TRANSMIT site, a Cellular Communications Kit utilizing a Sierra Airlink GX440 (or approved multi-protocol cell modem) compatible with Verizon service to supply data to the TRANSCOM server. The Contractor shall be responsible for all Verizon costs related to installation and operation of this equipment until the TRANSMIT reader sites have been accepted by the Authority.

Once the installation is commissioned by TRANSCOM and is in operation, the existing TRANSMIT equipment shall be de-commissioned and the equipment (cabinet, reader, antenna, etc.) shall be removed and delivered to the Supervisor of Maintenance at the Goethals Bridge Maintenance Facility.

2.08 UNINTERRUPTABLE POWER SUPPLY (UPS)

The Gantry ITS Cabinet at each of the three (3) main ITS Gantries shall be furnished with a UPS to maintain and provide conditioned power to key electronic devices as specified herein. The UPS shall be a rack mounted, environmentally hardened, true online double conversion

type. The UPS inverter shall be in operation at all times supplying clean regulated power to the specified loads. at all times. The UPS shall be equipped with extended temperature range Lithium Ion, Glass Mat VRLA, or approved equal batteries with an estimated life of ten (10) years and an external automatic bypass switch as specified herein.

The UPS and batteries shall be sized and wired to supply the following loads for a minimum of thirty (30) minutes in the event of a power failure:

- (2) VMS controllers
- (2) VSLS controllers
- (2) CCTV cameras, with PTZ, and video encoder (100 Watt max. load)
- Traffic metrics wireless access device (25 Watt max. load)
- Communications device(s) (i.e. router, modem, radio, network switch, etc.)

A. Operating Specifications

The UPS shall meet or exceed the following operating specifications:

1. Mechanical
   a. Dimensions: inches: 5.22H x 15.5W x 8.75D
   b. Weight: 35lbs
   c. Environmental:
   d. Operating temperature range: -40 to 74°C (-40 to 165°F)
   e. Audible noise @ 25°C: <45dBa @ 39in
   f. Performance:
   g. Typical output Voltage THD: <3%
   h. Typical efficiency: >98% (resistive load)
   i. Typical transfer time: <5ms
   j. Agency Compliance:
   k. Electrical safety: UL1778, CSA 22.2 No 107.3-03
   l. EMI Class A FCC/CISPR[EN 50091-2:1995]
2. Electrical
   a. Battery string Voltage: 48Vdc
   b. Nominal Voltage: 120Vac
   c. Nominal frequency: Auto-sensing
   d. Input:
   e. Current: 9.7A nominal Voltage: 85 to 175Vac
   f. Output:
   g. Current: 9.2A nominal
   h. Voltage regulation: +/- 10% over input Voltage range
   i. Power at 50°C: 1100W/VA
3. Communication Module
   a. Remote UPS Monitoring and Management
   b. HTTP: Hyper Text Transfer Protocol allows remote UPS monitoring and management through a web browser.

c. The following browsers are supported: Microsoft Internet Explorer 7, 8 and 9.

d. SNMP: Simple Network Management Protocol allows centralized UPS monitoring and management through a network management system such as HP Open View or SNMPC.

e. Proactive UPS Event Handling

f. Event Log: Automatically records and displays UPS events, warnings and time stamps.

g. UPS Status Notification: SNMP notifies multiple hosts of UPS status and warning messages.

h. Email Notification: Power events can be sent through email.

i. Intelligent UPS Management

j. User Scheduling: Allows configuration of scheduled settings for shutdown, startup and self-test functions.

k. Specifications

l. CPU: 32-bit micro controller

m. RAM: 8MB

n. Flash ROM: 4MB

o. LAN Interface: Auto-sense 10/100Mbps Fast Ethernet

p. Network Protocol: TCP/IP, UDP, SNMP, SNTP, HTTP, SMTP

q. LED INDICATION: LAN 10/100 Link active

r. Power Consumption: 3W max.

s. Miscellaneous: IP and hardware reset buttons

t. Language: English (default); supports all unicode-based languages

u. Firmware Upgrading: Network upgrade; fail-safe network upgrade

v. System Security: Password protection for system operation and administration

w. Approvals: CE, FCC Class B

B. UPS Communications and Alarms

1. The UPS shall include RS-232 serial, open-collector signal, and 10Base-T Ethernet ports for remote monitoring and control of the UPS and battery system.

2. The UPS RS-232 serial port shall be connected directly to the VMS controller to allow the controller to call back to the central control center for notification that local power has been lost. The VMS controller shall send a trap notification to the TMC and activate the NTCIP power loss message if configured to do so. Additionally, the UPS Ethernet port shall be connected to the ITS network switch to allow remote access to extended UPS status information.

C. Automatic Bypass Switch (ABS)

The UPS system shall include an external ABS made by the same manufacturer and fully compatible with the supplied UPS. The ABS shall be wired to the utility power and the UPS so that regenerated UPS power is supplied to the UPS loads via the UPS inverter while on utility power or battery power. In the event of a UPS failure or battery discharge, the ABS shall automatically bypass the UPS inverter and switch utility power to the UPS loads.

D. Emergency Shutdown Operation

The UPS system shall include an external emergency shutdown switch. The switch shall cut main power to the gantry and provide contacts to shut down the UPS, as shown on Drawing T0727. It shall be mounted to be accessible to emergency responders and shall be secured with a padlock keyed per Fire Department and Port Authority requirements.

2.09 POWER AND COMMUNICATION REQUIREMENTS

A. Convenience Outlets

The three (3) main ITS Gantry cabinets shall contain a utility outlet circuit consisting of a minimum of two (2) 15-A NEMA 15-R, 120 VAC duplex outlets, with ground-fault circuit interrupter positioned for optimum access and convenience. The convenience outlets shall not be connected to the UPS output.

B. Transient Protection

The signal and power inputs shall be protected from electrical spikes and transients as follows:

C. AC Mains Power

The AC power feed for all equipment shall be protected at the load center by a parallel-connection surge suppresser rated for a minimum surge of 10 KA.

D. Control Equipment AC Power

A series-connected surge suppressor capable of passing 15 Amps of current shall protect the sign controller and other control and communication equipment. This device shall conform to the following requirements:

1. Withstand a peak 50;000 Ampere surge current for an 8x20 microsecond waveform
2. Maximum continuous operating current of 15 Amps at 120 VAC, 60 Hz
3. Series inductance of 200 micro Henrys (nominal)
4. Temperature range of –40°F to +158°F (-40°C to +70°C)
5. Approximate dimensions of 3-inches wide by 5-inches long by 2-inches high (76 mm by 127 mm by 50 mm)
6. The device shall be UL-1449 recognized
7. UL-1449 surge rating of 400 V or less

E. Communication Signals

Transient Voltage surge suppressors shall protect all communication signals connecting the control equipment from off-site sources using copper cables. Transient Voltage surge suppressors shall protect all copper communication lines used to pass data between the sign controller and sign.

2.10 ITS CABINETS (NEMA 3R)

A. The Three (3) Sign Control Cabinet types shall be fabricated of Stainless Steel, Type 312, 14 Gauge minimum where possible:

1. Type 1-Daktronics – Includes Aux Control Panel, per DAK DWG # 1064824 (no substitutions)
2. Type 2a- TransCOM Reader is installed as one of the components of the Type 3 cabinet. This cabinet type was removed from this Contract.
3. Type 2b - APX TC443624 or approved equal.
4. Type 2c – Vaisala RTU Cabinet (See RWIS in 2.03)

5. Type 3-APX TCDD 724818 or approved equal.

B. ITS Cabinets shall be furnished and installed and equipped at the locations listed in Contract Drawing, T0719.

C. Equipment may be pre-installed before the cabinet is mounted to the structure where it is required. Remove and re-install any equipment that could be damaged during Contractor installation or other operations. ITS gantry wiring, to the extent possible, shall be contained within the gantry tubular structure.

D. Specifications

1. Dimensions: See Contract Drawing T0719.
2. Material: Stainless Steel, Type 312, 14Gauge minimum.
3. Finishes: Bare
4. Mounting: Gantry or Pole mount type.
5. Locking System : Three-point locking system with Corbin # 2 key.
   A padlock hasp shall also be included on all ITS Cabinet types.
6. Configuration: Bare Cabinet with removable self-standing rack. (For cabinet types 2 and 3 as shown on Contract Drawing T0719).
7. Light: Fluorescent– In cabinet types 1 and 3 only.
8. Shelf Drawer: Slide out shelf/drawer for laptop use. – In cabinet types 1 and 3 only.

2.11 ETHERNET SURGE PROTECTORS

The Ethernet Surge Protectors shall meet the environmental requirements of the equipment that each unit is protecting. They shall be HyperLink HGLN-CAT5EJW as manufactured by L-Com, Inc., or approved equal. An Ethernet Surge Protector shall be installed on each wired Ethernet cable that enters the ITS Cabinet.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect all Systems equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. Ensure that the spaces where any electronic equipment is to be stored and/or installed are completely free from any foreign substances, such as concrete dust, water, or any other material that may otherwise be harmful to electronic equipment and connections. No allowances shall be made to the Contractor for equipment damage, or delays due to environmental/security damage.

B. After the System equipment has been delivered, an on-site inspection will be conducted by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor will be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the System shall be installed by the Contractor.

3.03 INSTALLATION

A. The Contractor shall ensure that a representative of the system's manufacturer oversees the installation, system configuration, and testing. Testing shall include verification of proper sensor operation, access point operation, and communications to the Communications Desk

B. The Contractor shall ensure that a representative of the vehicle detection equipment manufacturer shall oversee, direct, and/or perform all required software installation, configuration and testing services as directed by the manufacturer and the Port Authority. Software services shall include configuration of each wireless detector, the wireless access point and the Port Authority's vehicle detection system central server as it pertains to the vehicle detection stations installed under this Contract.

C. The Contractor shall submit a written Final Acceptance Test Plan for approval prior to scheduling a Final Acceptance Test. The Final Acceptance Test shall include the following, and shall be completed after all components have been installed, configured, and integration-tested:

1. All diagnostic routines provided by the manufacturer
2. Proper wiring, grounding, and attachment to structure
3. Proper operation of the detection system, provided over a one-hour period comparing system counts to counts obtained by observation of live traffic
4. Accurate reporting of vehicle speed
5. Demonstration of real-time vehicle detection data received at the control room server
6. A 10-day operational test of all functionality from the control room

D. The Final Acceptance Test results shall be documented, signed by system manufacturer's representative and submitted to the Port Authority.

E. When Wireless Access Points are installed before the corresponding In-Pavement Wireless Sensors that they serve, the Contractor shall perform Final Acceptance Testing according to the following requirements:

1. Provide a temporary In-Pavement Wireless Sensor for use in testing. No additional payment shall be made for the furnishing of this sensor.
2. Place the Sensor on the shoulder pavement (without disturbing live traffic), in a location that is even with line of sensors furthest from the Wireless Access Point. The sensor need not be installed within the pavement for this test, but can be temporarily paced on the surface, protected from live traffic with a shoulder closing.
3. Demonstrate proper communications and that the central software recognizes the sensor by driving a vehicle multiple times above the sensor.

F. Repeat the test in the opposite roadway shoulder.

G. The vehicle detection station shall be installed according to the specifications described below:

1. Wireless Access Point Mounting
   a. The wireless access point shall be located as close to the in-pavement wireless sensors as possible. The wireless access point shall be mounted as shown in the Contract Drawings.

b. Install the Structure Mounted ITS Enclosure on the structure, and provide equipment within the enclosure. Terminate power and communications wiring at the ITS enclosure as per the manufacturer's directions. Install wiring from the ITS enclosure to the nearest junction box or junction box foundation and connection to POE power and communications for a fully operational system. Wiring on the ITS gantry structures, to the extent possible, shall be contained within the gantry tubular structure.

c. The Contractor shall install a Power Injector in the ITS Enclosure for a Structure mounted configuration, and shall connect it to the network cable feeding the Wireless Access Point in accordance with the manufacturer's directions. The Power Injector line cord shall be neatly labeled with the inscription "VDS-POE" near the receptacle plug using nylon identification cable ties with permanent ink marking, or printed adhesive backed labels with a clear protective outer layer.

2. In-pavement Wireless Sensor

a. Each in-pavement wireless sensor shall be installed in asphalt roadway by core drilling to provide a 4" diameter hole, 2.25" to 2.50" deep. A pre-fabricated hole shall be formed in the concrete deck by placement of foamed polyethylene, Styrofoam or equivalent plug inserts at the sensor locations, during deck fabrication. A thin layer of epoxy sufficient to cover the bottom of the hole shall be applied. The wireless sensor shall be placed in a clamshell enclosure on top of this layer of epoxy in the correct orientation as clearly marked on the sensor. The encased sensor shall be fully encapsulated with the epoxy to the lip of the cored hole with a minimum cover of .25" and no more than .50" of epoxy.

b. Each installation of the wireless battery-powered magnetometer vehicle detection system shall consist at a minimum of three (3) sensors installed in the center of each monitored traffic lane. The actual distances (center to center) between installed sensors shall be measured to the nearest 1/8th-inch, recorded and submitted to the Port Authority.

c. The Contractor shall test all the sensors and record their serial numbers before they are epoxied in the road. The Contractor shall keep accurate records of where each individual sensor (by serial number) is installed. Pre-epoxy testing shall be performed with the sensor at the final depth in each lane hole and shall verify proper communications with adequate signal strength at the wireless access point and the ability to detect vehicles after it is epoxied in place. The Contractor shall be required to remove and install new sensors or relocate sensors as required to achieve proper sensor to access point communications and vehicle detection without additional compensation.

d. Installation of the in-pavement sensors shall occur only after the final pavement overlay has been constructed. The Contractor and Port Authority shall field coordinate the schedule to determine the timeline of wireless access point equipment and in-pavement sensor installations.

e. The Contractor shall provide maintenance and protection of traffic, occupational safety and quality assurance as required by the design, installation and testing installation and testing of the equipment, hardware, firmware/software listed above.

3. VMS Installation Requirements

Variable message signs shall be installed in accordance with the manufacturer's specifications and recommendations. Where the controller cabinet is ground mounted, if possible, it shall be placed in an upstream location that affords

maintenance personnel the ability to view the VMS display from the cabinet. Care shall be taken to avoid dissimilar metal attachment as discussed in Section 05165 VMS Overhead Span Support Structure.

3.04 SPARE PARTS

The Contractor shall submit a schedule of Spare Parts that shall include at least 10% quantity of every type of ITS Equipment (this may include a complete VMS of each type and a VSLS and/or separate individual components for these signs, based on the quantities of each component supplied) furnished and installed by the Contractor on this Project. (Spare parts are not required for Vaisala RWIS or Transcom TRANSMIT equipment.) Units shall be rounded up to the next whole number if the result is fractional. Spare parts shall be delivered to the Supervisor of Maintenance at the Goethals Bridge Maintenance Facility. The delivery and acceptance of spare parts for each sub-system that requires them shall be completed before that sub-system will be considered for acceptance.

3.05 FIELD QUALITY CONTROL

A. Field Tests

1. System Acceptance Tests

   After all equipment, firmware/software, and communications links have been installed and calibrated, the Contractor shall test run the system to ensure that all specified functions are working properly. These tests shall be witnessed by the Authority and the Contractor shall demonstrate to the Authority that all traffic data conform to these Specifications.

2. Continuous Operating Test

   a. The continuous operating test shall be conducted by the Authority. The test period shall commence following the successful completion of the system acceptance testing and shall consist of continuous operation of the system's on-site equipment for 30 consecutive calendar days.

   b. Failure of any component of the system to record, store, and process data per the requirements set forth in these Specifications for an accumulated time exceeding 8 hours during the 30 day period shall be cause for the Contractor to correct any deficiencies and for the continuous operating test to be started over.

   c. Failure of the Host Computer or its peripheral equipment or of a communication link not furnished by the Contractor to transmit data shall not be cause for restarting the 30 day continuous operating test provided that the Contractor demonstrates to the satisfaction of PANYNJ that the failure is not caused by any of the Contractor furnished materials or equipment.

B. Warranty

Equipment shall have a minimum warranty period of five (5) years on all components from date of delivery. All equipment shall be provided and warranted by a single vendor per subsystem. Warranty shall include actual parts and labor for any warranty work performed at manufacturer's facility.

C. Maintenance

The Contractor shall be available 24 hours per day, 365 days per year for technical service assistance. Upon receipt of a service call after normal business hours, the Contractor shall respond within 30 minutes and be on-scene if determined necessary by the Engineer within 60 minutes of receiving the service call. If requested by the Engineer

to support operational needs, the Contractor shall provide equipment from the spare parts inventory (or loaned equipment as necessary) to the Authority while the equipment is being repaired or replaced by the Contractor. All service shall be fully documented with itemized repairs listing the equipment serial numbers, type of service performed, specific components replaced and date of service. The option for continued maintenance, after expiration of the warranty period shall be available and submitted as discussed in Appendix 'A'.

D. System Documentation

1. The Contractor shall provide documentation to describe the design, installation, operation and maintenance of the equipment and the communications system. The documentation shall be assembled in one package that is separated into sections. A minimum of five (5) complete copies shall be provided to the Authority. (System documentation is not required for Transcom TRANSMIT.)
2. Operation and Maintenance Manuals shall describe all operating procedures and shall be provided for the personnel who use and operate the systems and equipment for operations and traffic data collection functions. The Manuals shall include a general description of the equipment and its configuration, and shall state its intended use. Moreover, detailed instructions shall be provided for the use of both the Host Computer and the Interface Terminal.
3. A complete site documentation package that includes drawings of each type of equipment installed at the site shall be included in a plastic pouch secured to the door or side-panel of each ITS Cabinet.
4. The Contractor shall provide Software Maintenance Manuals for personnel with skills at the software technician level. The Contractor shall provide Operation and Maintenance Manuals and Software Maintenance Manuals to each end user attending (or prior to) the training sessions. A minimum of five (5) additional copies shall be provided to the Authority.
5. The Contractor shall submit 7 copies of system layout to the Engineer for review. After the review one copy of the reviewed drawings will be returned to the Contractor with written permission to construct. For software and system designs, the Contractor shall submit instrumentation diagrams and assembly and configuration instructions as part of the design.

E. Training

1. One full day of training shall be included at the conclusion of installation. Training shall be conducted by the manufacturer's technical service personnel or factory authorized representative. (Training is not required for TRANSCOM TRANSMIT.)
2. Prior to acceptance, a training program shall be provided for the Authority's engineering, maintenance and operations staff, at a location designated by the Authority. The training shall include all material and manuals required for each participant. The training shall be as follows:

F. Maintenance Training

The training shall be provided for a minimum of 40 hours for a minimum of five (5) maintenance personnel. The training shall include operation instructions, theory of operation, circuit description, preventive maintenance procedures, troubleshooting and repair of all equipment including: transmitter, data recorder and all other equipment specified herein.

G. Operation Training

The training shall be provided for a minimum of 16 hours for a minimum of five (5) operation personnel. The training shall include demonstrations of actual control of the system software with operation of spare hardware.

END OF SECTION

SECTION 16792

APPENDIX "A"

INTELLIGENT TRANSPORTATION SYSTEM

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, As-Builts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Submittal Schedule

B. Construction schedule, indicating the number of calendar days from acceptance of the Contractor's Proposal that each milestone of the Work will be completed, including (but not necessarily limited to) the following:

1. ITS device installation schedule
2. Field Acceptance testing Plan
3. Training schedule
4. Video data base modification to the Agency Centralized Video Server schedule

C. Contractor shall submit, within Thirty (30) days before the scheduled day of work, an overall System Installation Procedure and Test Plan.

D. Complete Bill of Materials for each site

E. Shop Drawings

1. Installation details of the equipment being furnished and/or installed under this Contract which shall include, but not be limited to cabinet elevation drawings and cabling diagrams.
2. Elevations of all field interface equipment and device termination equipment.
3. Port assignment of DC power and Ethernet ports to IP switches.

F. System Documentation

Three (3) complete sets of documentation shall be submitted, explaining all system capabilities and options, including system set-up, operation, and maintenance (software manuals shall be supplied in hard copy only) for the following at a minimum.

G. Operational Documentation

1. Fifteen (15) complete sets of User Training manuals, three (3) complete sets of Administrator Training Manuals, four (4) complete sets of both User and Administer Manuals for the file, shall be submitted which shall, at a minimum, consist of the following:
2. Detailed description of normal System operations.

H. Hardware Documentation

1. Complete hardware list with description, manufacturer, model #, and
2. serial #.

I. Training Syllabus for each course at least one month before the training course is to be offered.

J. Field Acceptance Test Plan

1. The Contractor shall submit the following test procedures as part of the Field Acceptance Test, no less than thirty (30) days prior to scheduled test date:
2. Field Acceptance Test Report
3. Operational Test Plan
   a. Catalog Cuts for all systems equipment.
   b. Record documents.

K. A copy of the written warranty shall be submitted.

L. Maintenance Contact information shall be submitted.

M. A Spare Parts Schedule that meets the quantity requirements of Sub-Section 3.04 shall be submitted. Spare parts shall be supplied and accepted before acceptance is considered for the systems or equipment that they are supplied to serve.

N. System Documentation described in 3.05 D.

END OF APPENDIX "A"

DIVISION 16

SECTION 16793

FURNISH AND INSTALL MICROWAVE SENSOR ASSEMBLY

PART 1. GENERAL

1.01 SUMMARY

This section describes the requirements to furnish, install, integrate, and maintain microwave sensor assemblies to support traffic signal adaptive and actuated operations during the entire construction period of the Bayonne Bridge. The Port Authority of New York & New Jersey hereafter referred to as the Authority is responsible for exercising direct supervision of the execution of the Contract. New York City Department of Transportation (NYCDOT) and its contractors are responsible to operate and maintain the traffic signals, the New York City Wireless Network (NYCWiN) communications, the Traffic Control System (TCS), and the Adaptive Control Decision Support System (ACDSS).

A. The Contractor shall furnish and install a microwave sensor assembly including a microwave sensor, a sensor cabinet and associated cabinet equipment, a wireless data transmitter, a wireless data receiver and expansion cards, antennas, surge arrestors, cables, and connectors to provide loop emulation contact closure outputs into an Advanced Solid-state Traffic Controller (ASTC) through the ASTC cabinet input file in accordance with the contract documents. The Contractor shall provide input devices suitable for mounting in the ASTC input file to support up to 8 detection zones as necessary to support the number of detection zones shown on the plans.

B. NYCDOT will replace the ASTC controllers, prepare ASTC signal timing database, install the NYCWiN Class 4 boxes, and integrate the microwave sensor into the Traffic Control System at the Transportation Management Center (TMC) located at Queens Blvd 3402, Long Island City. The Contractor shall notify the Authority and NYCDOT once the installation of the microwave sensors is complete. Upon the microwave sensors are integrated into the NYCDOT's TCS, the Contractor shall be responsible for integrating the microwave sensors and ASTC traffic controllers into the NYCDOT Adaptive Control Decision Support System at the TMC by hiring a NYCDOT approved adaptive signal control support consultant. The Contractor, along with the NYCDOT approved consultant, shall be responsible for maintaining the microwave sensors to support traffic signal adaptive and actuated operations by NYCDOT during the entire construction period of the Bayonne Bridge. The traffic signal locations are shown on the plans.

C. The sensor unit shall be a self-contained microwave sensor integrated with a wireless data transmitter and an antenna either as a single unit within a single enclosure or as separate components installed in the sensor cabinet, which detects and monitors roadway traffic and transmits sensor information to a wireless data receiver. The sensor shall be a true presence detector which can provide presence, volume, lane occupancy, and speed information on at least eight discreet detection zones from a side-fire or forward looking location. The sensor volume and occupancy information shall be available via loop emulation contact closure outputs for up to 8 detection zones. The sensor shall also provide all information via RS-232 asynchronous serial communications using an open protocol or a proprietary protocol that NYCDOT has the right to make freely available to future perspective bidders and contractors. The wireless data transmitter shall transmit the sensor information to an associated wireless receiver housed in an ASTC cabinet as shown on the plans.

D. The wireless data receiver and its reporting transmitters shall be configured for point-to-multipoint communications. Each receiver shall simultaneously communicate with up to 8 transmitters. The receiver shall be mounted in the ASTC input file and accommodate up to 8 detection zones in a loop emulation configuration for collecting volume and occupancy data from its reporting sensors.

E. The microwave sensor, wireless data transmitter and receiver, antennas, surge arrestors, cables, and connectors shall be furnished as a complete factory tested assembly. The sensor cabinet and associated cabinet equipment shall be furnished as a complete assembly with all internal hardware and wiring factory installed and tested, and all mounting hardware required to complete the installation. The Contractor shall provide software, firmware, and any equipment required to setup, calibrate, and operate the microwave sensors, wireless data transmitters and receivers.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	The City of New York, Department of Transportation (NYCDOT)
NYCDOT	Street Lighting Section, Specifications - 1992 Edition.
NYCDOT	Street Lighting Section, Standard Drawings - 1992 Edition
NYCDOT	Systems Engineering Division, Specifications for Furnishing All Labor and Material Necessary for Installation, Removal and Maintenance of Signal And Intelligent Transportation Systems - July 2010.
NYCDOT	ASTC Procurement Specification Version 2.6
	National Electrical Manufacturers Association (NEMA)
NEMA	NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements Version 02.06

1.03 SCOPE OF WORK

The Work specified under this Section includes the following devices that the Contractor shall furnish, install, configure, integrate, and maintain as part of the Contract. The Contractor shall be responsible for the entire installation from end to end, including microwave sensor, microwave sensor cabinet, wireless receiver antenna, and wireless receiver installed inside the ASTC cabinet by the Contractor. The Contractor shall include

the costs to furnish and install all necessary conduits, cables and mounting hardware to make the system fully functional. The Contractor shall also include the costs for the NYCDOT approved adaptive signal control support consultant to make operational and maintain the ACDSS system for traffic signal adaptive and actuated operations during the entire construction period of the Bayonne Bridge.

The Contractor shall coordinate the Work with the Engineer and NYCDOT, complete all required installations, and make the adaptive and actuated signal operations fully operational prior to any Bayonne Bridge construction related lane closure, lane shift, traffic detour, and other major change to the traffic pattern.

The Contractor shall provide maintenance of all sensor assemblies that the Contractor is responsible for installing throughout the Contract duration. Any equipment malfunction or failures shall be repaired or replaced and made fully operational within twenty-four (24) hours upon notification by the Engineer at no cost to the Authority and NYCDOT.

The Contractor shall be responsible for microwave sensor reconfiguration and recalibration as necessary throughout the Contract in order to ensure continuous operation of the microwave sensors and traffic signal control within the Project limits. Reconfiguration and recalibration of microwave sensors shall be completed immediately after changes to lane configurations and detection zones, replacement of any defective equipment or upon notification by the Engineer.

The Contractor shall be responsible to meet the microwave sensor performance requirements as specified in the following requirement sections. The Contractor shall provide the necessary data and reports to the Authority for the operational analysis and evaluation of the adaptive and actuated signal operations during the entire construction period of the Bayonne Bridge.

Approximate Quantity	Unit	Microwave Sensor Component
18	Each	Furnish microwave sensor including microwave sensor and wireless data transmitter including all mounting brackets
18	Each	Furnish and install 25-ft interface cable per microwave sensor and associated conduits, weather heads and all mounting brackets and appurtenances
18	Each	Furnish and install microwave sensor cabinet with associated cabinet equipment, conduit, and all electrical wiring including connection to the power feed
6	Each	Furnish and install microwave sensor wireless receiver and antenna including all required extension cards, surge arrestors, wiring and appurtenances inside the ASTC cabinet
6	Each	Furnish and install 30-ft antenna cable per wireless receiver including weather head, mounting brackets and appurtenances
17	Each	Install microwave sensor assembly on wood pole
1	Each	Install microwave sensor assembly on metal pole
1	Lump Sum	Adaptive signal control support from a NYCDOT approved consultant

1.04 QUALITY ASSURANCE

A. Unless otherwise specified, the Contractor shall be responsible for all inspection requirements prior to submission for the Authority inspection and acceptance. The Authority reserves the right to perform any additional inspections deemed necessary to assure that the equipment conforms to the requirements specified herein. The Authority reserves the right to have its representatives witness all factory tests. The results of each test performed by the manufacturer shall be compared with the requirements specified herein. Failure to conform to requirements for any test shall be counted as a defect, and the equipment shall be subject to rejection. Rejected equipment may be offered again for retest provided all non-compliance has been corrected and re-tested by the Contractor. Final inspection and acceptance of equipment shall be made after delivery at destination specified unless otherwise stated.

B. All equipment furnished under this item shall be approved by the Engineer prior to the purchase. The Contractor shall submit the manufacturer names, equipment model numbers, catalog cut sheets, and other descriptive materials for all equipment and components proposed under this pay item for approval by the Engineer.

C. Three (3) randomly selected samples shall be delivered for inspection and testing within forty-five (45) consecutive calendar days after notice from the Authority, and upon receipt of this notice, the Contractor shall also submit six (6) complete sets of working drawings to the Engineer. Failure to submit the samples and drawings within the time specified will be sufficient reason to declare the Contractor not in compliance and ineligible for award of the Contract. Samples will be returned to the Contractor upon NYCDOT completion of its inspection and testing.

D. The microwave sensor assembly construction and installation shall be inspected and accepted by the Authority and NYCDOT before they are integrated with the ASTC controllers and the rest of the system. Two (2) weeks notice shall be given to the Authority and NYCDOT prior to the scheduled inspection date. The Contractor shall provide a minimum of two weeks for the Authority and NYCDOT to inspect and accept the construction and installation.

E. Documentation and Shop Drawings

1. The Contractor shall provide complete maintenance and operation manual, which includes schematics, component layout, bill of materials with generic manufacturer's part numbers, assembly and disassembly instructions, calibration procedures, exploded assembly drawings, protocol documentation, and complete instructions for the installation and use of the laptop PC setup and calibration procedures. Documentation shall be bound.

2. The Contractor shall provide the setup and configuration software on a CD including automatic installation and removal procedures along with the Contractor supplied equipment without additional charges. NYCDOT shall have the right to copy and install the software as necessary to support the setup, maintenance, and operation of the microwave sensor, wireless transmitter and receiver for NYCDOT or contract maintenance personnel.

3. The Contractor shall prepare shop drawings detailing the complete microwave sensor, wireless data transmitter and receiver assembly, all components to be supplied and the mounting hardware. These drawings shall detail typical placement of each sensor at all structure mounting and aiming configurations and show the proposed height the unit is mounted at, the proposed detection zone and hardware mounting methods. These drawings shall include details of the installation of the interface cable from the sensor to the sensor cabinet, including the RS-232 and contact closure output terminations. These drawings shall also detail typical installations of the wireless data receiver and associated equipment at the ASTC cabinet. All drawings shall not exceed 11"x17" and shall foldout where required. An electronic version of the drawings shall be provided on a Compact Disk (CD) based on AutoCAD 2000 (or latest version) application software for a personal computer.

4. The number of hard copies of the documentation to be provided shall be at least one per trainee and not less than 10 with each order. The documentation shall also be provided on CD and NYCDOT shall have the right to make whatever copies are necessary to support the use and maintenance of the sensor, wireless transmitter and receiver.

5. All protocols used for the setup, configuration, and operation of the microwave sensor, wireless data transmitter and receiver shall be fully and completely documented. Undocumented messages and data elements are prohibited. This information shall include all messages, configuration information, timing, and sequences of messages. Such information shall be complete and cover all aspects of the sensor operation and wireless communications including setup and error conditions.

6. Reproducible shop drawings of the electrical schematics and mechanical details for the unit and all mounting configurations shall be supplied to the Engineer and/or with the delivery of the equipment.

1.05 DELIVERY

A. The samples shall be delivered to the NYCDOT ITS LAB, Room 122, 34-02 Queens Blvd, Long Island City, NY 11101, Phone number 718 786 3223, within delivery time frame as directed by the Engineer.

B. The Contractor shall furnish all labor, dunnage, blocking, wedges and other equipment necessary for the safe delivery, stacking and storing of material under this Contract, satisfactory to the Engineer.

C. The Contractor shall pre-pay all transportation, handling and delivery charges associated with this Contract.

1.06 GUARANTEES

A. The Contractor guarantees that all articles of equipment including all parts thereof are of the first quality throughout and comply in all respects or are fully equal to standards called for in the specification. The Contractor further guarantees all equipment, and all parts thereof against any defects of workmanship, construction and materials, and guarantees to repair or replace without cost to the Authority and NYCDOT any article that had become defective, and not proven to have been caused by negligence on the part of the user, throughout the Contract and within a period of twelve (12) months after completion of the Contract. The Contractor shall obtain a minimum period of twelve (12) months (from the Contract end date) manufacture warranty for all microwave sensor assembles installed by the Contractor. A guarantee certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The guarantee certificate shall name NYCDOT as the recipient of the service. NYCDOT shall have the right to transfer this service to other private parties who may be contracted to perform overall maintenance.

B. The guarantee shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more then two (2) weeks from date of receipt and the provider of the warranty shall be responsible for all shipping costs. The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service.

C. In the event of failure on the part of the Contractor to replace or put in first-class condition any such articles within thirty (30) calendar days from the date of notice, NYCDOT may have the work done by others and charge the cost to money due, or if there be no money due, the Contractor agrees to pay NYCDOT such costs.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. DESIGN AND PERFORMANCE REQUIREMENTS

2.01 GENERAL REQUIREMENTS

A. All of the components, including all incidental components and cables, shall be supplied to accomplish a fully operational installation. All equipment and component parts furnished shall be new and of the latest design. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices. The design life of all components, operating 24 hours per day 365 days per year, shall be ten (10) years minimum.

B. The microwave sensor, wireless data transmitter and receiver shall be fully compatible with each other and shall be supplied from the same manufacturer or a third party manufacturer as approved by the Engineer. The wireless data receiver shall be fully compatible with the ASTC input file as specified in New York City Department of Transportation ASTC Procurement Specification Version 2.6 Sections 2.5, 2.6, 2.7, 2.8.6, 3.4.1, 3.10.3, 3.10.5 and 5.11.

C. Prior to commencing work on this item, the Contractor shall provide the Engineer with evidence of the microwave sensor manufacturer either having provided at least three successful detector installations of fifty or more sensors identical to the model proposed in an operational system of similar scope over three (3) years, or the experience of comparable system complexity as judged by the Engineer. The submittal shall include the names and phone numbers of users familiar with the installations.

2.02 FUNCTIONAL REQUIREMENTS

A. Microwave Sensor

The microwave sensor shall be designed for mounting on a site specific basis as shown in the contract documents or as directed by the Engineer from a side-fire or forward looking position on a traffic signal pole, street light pole, sign structure vertical support post or chord member, or vertical concrete or steel surface. The material of the structure to which it is mounted shall not affect its operation. The sensor shall comply with the following functional requirements:

1. The sensor shall comply with the limits of Part 15 of the FCC rules for low-power, unlicensed, continuous microwave transmitter operation. The unit shall not interfere with any known equipment.
2. In a side-fired position, the sensor shall support at least eight lanes of traffic over a maximum range of 200 feet from the microwave sensor when the sensor is mounted at least 17 feet higher than the roadway surface and at a distance of minimum 15 feet from the edge of the closest travel lane. The shoulder or parking lane shall not be considered as a travel lane. The sensor shall support the zero set back configuration.
3. The width and location of the detection zones shall be fully programmable locally via an RS-232 serial port using a laptop computer. The sensor shall retain all fine-tuning and configuration data in nonvolatile memory. The serial port shall be located in the sensor cabinet as specified herein. An interface cable shall be provided between the sensor cabinet and the sensor unit.
4. The detection zones shall be programmable remotely via the wireless link using the RS-232 serial port on the wireless data receiver inside the ASTC cabinet.
5. Time resolution of the sensor shall be 10 milliseconds or less.
6. The sensor shall be programmed to provide loop emulation volume and occupancy data via contact closure outputs for eight detection zones using the wireless link to a remote ASTC controller. The volume, occupancy and speed data shall be available via the RS-232 port through the interface cable when access to such data at the sensor cabinet is required. It is not required that the sensor provide the data via the wireless link and via the interface cable simultaneously. The wireless link may be disabled if access to the data at the sensor cabinet is established through the interface cable.
7. The reporting interval shall be set within the range of 10 to 900 seconds in increments of ten seconds. The sensor shall support both contention and polled-response modes. In contention mode the sensor shall report volume, average occupancy, and average speed over the reporting interval at the end of the interval. In polled-response mode, a communication address shall be assigned to the unit via its setup program. Upon receiving a command with the appropriate address, the sensor shall respond with the accumulated volume, average occupancy, and average speed in the period since the last poll request is issued.

8. Support for the National Transportation Communications for ITS Protocol (NTCIP) is optional and not required for this project. However, if the unit is capable of supporting NTCIP, then the Management Information Base (MIB) shall not be proprietary. The vendor shall indicate how their unit supports the NTCIP for the collection of the volume, occupancy, and speeds for each of the detection zones and how to use NTCIP to configure the unit. An electronic copy of the MIB shall be provided upon award of the contract and may be published by NYCDOT for use on future contracts. The protocol shall support the sensor setup and configuration from a local laptop and from a remote location. Complete protocol descriptions shall be supplied with the submittal for the sensor. These protocol descriptions shall be complete and adequate for future development of software to retrieve the information from the sensor. The microwave sensor shall be capable of being configured as a stand-alone detector from which a remote location shall be able to retrieve the collected data and sensor status through a serial connection. The remote location shall also be able to command the sensor to change the sensor setup (for example, reset clock). The microwave sensor may support both Simple Network Management Protocol (SNMP) and Simple Transportation Management Protocol (STMP) protocols over the serial interface. If the vendor elects to provide custom objects for the control of the microwave sensor, such custom objects shall be well documented and shall be publicly available. Proprietary protocols are not allowed unless NYCDOT has the right to make this information freely available to future perspective bidders and contractors.

9. The sensor shall support a multi-drop configuration and enable a group of sensors within a range of at least 1000 ft.

10. The sensor shall be able to locally store vehicle volume, occupancy, and speed data for each detection zone in 1 to 60-minute intervals for a minimum of 10 days.

11. Removal of the sensor unit for firmware upgrade is not allowed. The sensor firmware shall be upgradeable via the RS-232 serial interface using a laptop computer by connecting to the serial port inside the sensor cabinet.

12. Performance requirements

    The sensor shall be capable of detecting vehicles traveling in either direction towards or away from the sensor in the detection zone as programmed by the user. The sensor shall operate in all traffic conditions from 10 mile/h to 100 mile/h. The accuracy specified herein shall be met for all vehicles traveling in rain, snow, fog, and winds up to 100 mile/h. The presence of median barriers, guide rails, and other obstacles separated from the travel lane by more than 10 feet shall not degrade the accuracy.

    a. Presence within the detection zone shall be accurate to within ±5% of ground truth.

    b. Per lane volume count data shall be accurate to within ±5% of ground truth vehicle count, where ground truth is provided by manual counts.

    c. Lane occupancy shall be accurate within ±20% of occupancy as measured by a properly functioning 6 x 6 foot loop. For instance, if true occupancy is 20% as measured by a 6 x 6 foot loop, reported occupancy from microwave sensor shall be within the 16% to 24% range.

d. Speed shall be accurate within ±10% of true speed as measured by a radar or laser gun when speed is above 30 mile/h, and within ±20% of true speed as measured by a radar or laser gun when speed is equal to or less than 30 mile/h. For instance, if true speed averages 50 mile/h, reported speed shall be 45 mile/h to 55 mile/h.

e. The sensor shall be able to differentiate long and mid-size vehicles from short vehicles and provide a count for each category via the serial interface. The three categories shall be programmable using the laptop configuration software.

The above criteria shall be met for at least 90% of samples collected and without the need for any reconfiguration to the microwave sensor. The automatic calibration capability shall automatically ensure that the sensor shall meet the performance requirements specified herein. The Contractor shall provide the Engineer with certificates of compliance for the above requirements. The Engineer reserves the right to verify all test results.

B. Wireless Data Transmitter and Receiver

The wireless data transmitter shall consist of an internal modem housed in the sensor enclosure or an external modem installed in the sensor cabinet. The wireless data receiver shall be designed for mounting in the input file in the ASTC cabinet. The wireless data transmitter and receiver shall comply with the following functional requirements:

1. The wireless data transmitter and receiver shall comply with Part 15 of the FCC rules and utilize license-free Frequency Hopping Spread Spectrum (FHSS) technology using 902-928 MHz frequency band. Frequency shall not interfere with the toll tag readers or any other known devices.

2. The wireless data receiver and its reporting transmitters shall be configured as point-to-multipoint communications. Up to 8 transmitters shall communicate to one receiver simultaneously and shall operate properly at a distance of at least 1000 ft. The receiver and its reporting transmitters shall be fully operational in an overlapping area where other transmitters and/or receivers present when they operate at different frequency patterns. Mean time between failures (MTBF) of the wireless transmitter and receiver shall be no less than 90,000 hours.

3. The wireless data transmitter shall collect, convert, and transmit detection data for up to 8 detection zones from the microwave sensor to the wireless data receiver.

4. The wireless data transmitter shall be capable of being configured as a repeater and installed between the upstream transmitter and the receiver as necessary when lack of line-of-sight or long transmission distance occurs between them. The repeater shall relay signals from the upstream transmitter to the receiver and vice versa. Utilizing the repeater shall be transparent to both the upstream transmitter and the receiver and shall meet all functional requirements contained herein.

5. The wireless data receiver shall receive data from up to 8 transmitters with up to 8 detection zones and process and convert the data to contact closure outputs that emulate up to 8 loops.

6. The delay between a vehicle presence in the detection zone and an emulated contact closure output to the input file shall not be greater than 1 second.

7. The wireless data receiver shall be configured as a Type 170 input file card, which shall be rack mountable on the ASTC input file as a plug-in unit. No rewiring of the ASTC cabinet shall be allowed. The receiver card shall output four (4) channels to the input file through its 22-Pin edge connector. Expansion cards shall be used in the case that more than 4 channels are needed. Each expansion card shall output two or four channels to the input file through its 22-Pin edge connector. Each receiver or expansion card shall use either one or two slots on the input file rack. The connection between the extension card and the receiver card shall be daisy-chained and accessible in the front. All input file plug-in cards shall support hot insertion and removal and it shall not be necessary to power down the cabinet when installing or replacing the cards. Such hot insertion and removal shall not damage the device, subject the operator to hazardous voltages, or cause improper controller operation.

8. Each receiver and expansion card shall be capable of being configured for single loop emulation card that only send volume and occupancy contact closure data to the controller, i.e., 2 channels for 2 loops, and 4 channels for 4 loops.

9. Each receiver and expansion card shall have indications for power, communications, as well as the real-time display of each contact output state. The indications shall be visible from the front. Each receiver and expansion card shall also include a test switch for each channel, which shall be front accessible to place a call to controller for maintenance and testing.

10. The sensor wireless data transmitter and receiver shall be fully programmable via an RS-232 serial interface using a laptop computer. The transmitter and receiver shall retain all configuration data in nonvolatile memory. The serial interface to the transmitter shall be accessible through the interface cable at the sensor cabinet. The serial interface to the receiver shall be accessible in the front of the receiver.

11. Detector data as specified herein shall be available via the RS-232 serial interfaces at the sensor cabinet and at the receiver end.

12. The antenna for the wireless transmitter may be attached to the sensor enclosure as a single unit.

13. The antenna for the wireless receiver shall be capable of being mounted on any pole or structure where the ASTC cabinet is located. The antenna, surge arrestor, antenna cable, and connectors for the wireless receiver shall be provided as approved by the Engineer. The antenna cable's length shall be at least 30 feet or as specified in the contract documents. The antenna cable connector shall be accessible in the front of the receiver. The surge arrestor and associated jumper and grounding cables shall be provided for protecting the receiver and traffic control equipment in the ASTC cabinet from the effects of electrical surges caused lightning strikes.

14. The microwave sensor shall have blue tooth capabilities to allow for programming of unit without a hard wire connection at the local site.

C. Configuration Software

A laptop PC based diagnostic and configuration software package, which operate under Windows XP or newer on any Windows compatible laptop, shall be provided. The software package shall comply with the following functional requirements:

1. The software package shall provide for the setup, configuration, calibration, and operation of the sensors, wireless data transmitters and receivers. The software shall be provided on a Compact Disk (CD) as a complete installation package.

2. The software shall provide both manual and automatic setup and calibration. The software shall fully support the programming of all parameters in the unit including type of protocol and detection zones. The software shall also display real-time presence in the programmed detector zones and shall also report the accumulated data over the reporting interval for all programmed zones including volume, average occupancy, and average speed, and vehicle classification.

3. The software shall save the configuration data for each sensor, wireless data transmitter and receiver to a back-up file that can be read on any laptop running the configuration software.

4. The software shall be able to display the real-time spread spectrum radio signal levels for all available hopping patterns and automatically or manually select an optimum pattern at both transmitter and receiver ends.

5. The software shall be able to setup, configure, calibrate, and operate the sensor from a local laptop as the serial communications is established at the sensor cabinet, or from a remote laptop as the serial communications is established at the receiver end. The software on the remote laptop shall be able to configure and operate multiple reporting sensors and retrieve detection data from them at the receiver end. Configuring one sensor shall not disturb the operation of other reporting sensors.

2.03 MECHANICAL REQUIREMENTS

A. Microwave Sensor

The sensor enclosure shall be a weatherproof box of cast aluminum, stainless steel, or polycarbonate meeting as a minimum NEMA requirements for a 4X Type enclosure and suitable for mounting on either a pole or other structure fabricated out of aluminum, steel, concrete, stone, or wood. The cables and harness shall enter at the rear and/or the bottom of the enclosure with sealing gaskets at entry points to prevent air and moisture entry. Maximum overall dimensions including fittings shall not exceed 14 in x 11 in x 6 in. Maximum weight of the sensor including wireless transmitter and antenna shall not exceed 5 pounds.

B. Sensor Cabinet

1. Cabinet Housing

a. The cabinet housing shall be weatherproof and rainproof with the top of the enclosure either crowned or sloped to prevent standing water. The cabinet shall be constructed to shield the top of the cabinet door to prevent water from entering between the top door gasket and the cabinet.

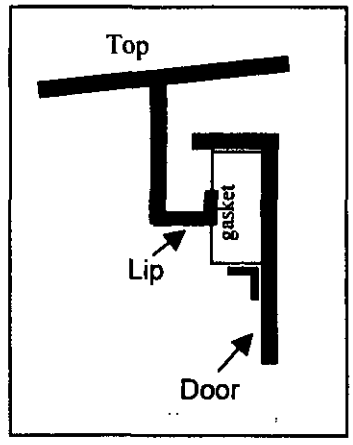
b. The cabinet housing shall have a single front door, equipped with a three-point latch and lock. The cabinet shall be fabricated for side of pole mounting and shall be suitably re-enforced for both pole mounting.

c. All exterior seams and the cabinet as a whole shall meet the requirements for Type 3R enclosures according to NEMA Standards Publication 250-1991.

d. The cabinet shall be clean-cut in design and appearance. The maximum exterior dimensions, including the cabinet door (but not including the removable handle) shall be as follows:

24 inches High by 18 inches Wide by 10 inches Deep (Plus or Minus 1")

2. Material



The cabinet housing, doors, and gasket channels shall be fabricated of 0.1875-inch minimum thickness sheet aluminum, using Grade 5052-H32 aluminum alloy. The sheet aluminum shall be adequately reinforced as necessary. If necessary, reinforcing supports shall be welded to the inside of the door to prevent the warping or twisting of the door. Note that a minor deviation was allowed for the current cabinet in the form of a lip using 0.125 inch material at the top of the door to improve water management over the door opening – see figure at the right. This deviation to the 0.1875 inch thickness requirement will be allowed providing all seams for this lip are continuously welded and only the top lip of the door opening is so modified. (Such a deviation must be submitted for approval by the Engineer)

3. Construction

a. All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance. All exterior seams for the cabinet housing and door shall be continuously welded and shall be smooth and free of impurities. All exterior corners shall be rounded.

b. There shall be no sharp edges or protrusions on the cabinet whether open or closed which might pose a risk of personnel cuts or injury. All sharp edges shall be sanded and deburred before painting.

4. Exterior Surfaces

The exterior surface of the controller cabinet shall be powder coated, using medium green to match Federal Specification 595B Color 14062.

5. Gasketing

a. The housing shall have a door, securely gasketed, which shall include substantially the full area of the front of the cabinet. Gasketing shall be provided on all door openings and shall be of dust-tight permanent type that will not peel off or deteriorate. Gaskets shall be 0.25-inch minimum thickness closed cell neoprene and shall be installed with contact cement for a permanent bond. The mating surface shall be sprayed or otherwise coated with a silicon lubricant to prevent sticking to the mating metal surface.

b. The gasket material shall not be damaged by normal cabinet cleaning agents and solvents normally used to remove graffiti from the exterior of the cabinet.

c. Gasket material shall be UV resistant.

d. The design of the door and gasket shall be such that the integrity of the gasket material shall not be required to ensure that the internal cabinet assemblies are protected from water damage under adverse environmental conditions. Cabinet door assemblies shall be designed in such a way that damaged gaskets do not allow water to enter the cabinet.

e. Gasket material shall be continuous along the entire top of the cabinet door with no seams or joints in this section.

6. Cabinet Door

a. The cabinet door shall be hinged on the right side when facing the cabinet. The door hinge shall be continuous and bolted (piano) to the cabinet and door utilizing ¼ - 20 stainless steel carriage bolts and nylock nuts. The hinge shall be made of 0.075 inch stainless steel and shall have a 3 inch open width with a 0.250 inch diameter stainless steel carriage hinge pin. The hinge pin shall be capped top and bottom by weld to render it tamper proof. The hinge leafs shall not be surface mounted on the outside of the cabinet. They shall be mounted between the door and the cabinet. The cabinet door hinges shall be bolted to the cabinet housing in a manner that prevents unauthorized personnel from removing the door with commonly available tools.

b. The cabinet shall be equipped with an automatic, self-engaging catch to hold the door open at 135 degrees (± 25 degrees). The catch shall be capable of holding the door open in 140 miles per hour wind coming at an incidence angle of 90 degrees referenced to the plane of the door. A means shall be provided to minimize the accidental release of the doorstop. The catch shall also be easily and reliably disengaged when closing the door so that the door and catch are not damaged.

c. The door shall be furnished with a three-point latching mechanism. The latching mechanism shall be a three-point draw roller type. Push rods shall be turned edgewise at the outward supports and shall be 0.250 inch by 0.750 inch stainless steel, minimum. Rollers shall have a minimum diameter of .875 inch and shall be made of *nylon*. The center catch shall be fabricated from 0.134 inch stainless steel minimum. Stainless steel compensating wear guards shall be used at contact point for the three point latching; these shall be pop or blind riveted to the cabinet.

d. The three-point locking mechanism shall be fabricated so that it may be actuated by rotating a removable 5/8-inch hex key door handle. The hex socket and locking cam shall rotate on a 0.5-inch minimum diameter shaft. The socket, shaft and hex key shall be fabricated from stainless steel, grade 2011P3 aluminum, or other material plated to prevent corrosion. The socket and shaft shall be field-replaceable with common tools. The socket head shall be protected from being rotated with a pipe wrench or similar tool. Designs shall be subject to approval by the Engineer prior to fabrication. One (1) hex wrench shall be provided with each cabinet.

7. Water Management

a. *The cabinet shall be constructed such that defective, aged, and damaged gasket* material shall not allow water to enter the cabinet in any areas that might cause damage to the equipment or wiring mounted inside or the operation of the signals.

b. The cabinet shall properly manage any condensation which may occur internally such that moisture cannot damage any of the internal cabinet assemblies, subassemblies, wiring or devices.

c. There shall be no holes, seams, or attachments to the top of the cabinet that might cause water to leak for any reason.

d. Weep holes approximately 3/16 inch in diameter shall be drilled in the bottom floor of the cabinet such that water does not accumulate in the cabinet.

8. Door Lock

a. The lock for the cabinet door shall be of the self-locking, heavy duty, pin tumbler, cylinder rim type. It shall be the Corbin No. 1548RS 7/8, keyed for a DT-9 key, with dust cover. Two DT-9 keys, constructed of brass or stainless steel are to be furnished with each cabinet. When the door is closed and latched, with the key removed, the door shall lock.

b. During the installation of the lock, good grade of commercial silicone will be put around the cylinder to form a weather barrier between the front of the lock and the inside of the cabinet door. A stainless steel lock protector plate shall be installed over the rear of the lock to prevent the rear of the lock from being punched out from the front of the cabinet.

9. Cabinet Ventilation

a. Each cabinet shall be provided with louvered vents in the cabinet door for fresh air. The vents shall be screened against the entrance to remove dust and foreign matter, with a removable and replaceable air filter 16 inch x 6 inch x 1 inch deep to filter incoming air. The filter shall be *Eco Air* type disposable filter or equivalent [reference: Eco-Air Products, Inc., San Diego, CA 92126, 619-271-8111] which is currently used and stocked by NYCDOT. The filter shall be a UL classified air filter-Class 2 644N.

b. The filter shall overlap the vents by at least 1 inch and shall be held firmly in place with bottom and side brackets and a spring-loaded upper clamp. Provisions shall be made in the design of the vents to prevent snow and rain from being blown through the vents into the cabinet.

c. The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered vents shall be designed and constructed so that a stream of water from a pressure head, such as a Rainbird sprinkler or other type of water spray test, will not enter the cabinet. The louvered area shall be less than the filtered area.

10. Cabinet Exhaust Fan

The cabinet shall be equipped with an electric exhaust fan and meet the requirements as specified in New York City Department of Transportation ASTC Procurement Specification Version 2.6 Section 3.1.10.

11. Cabinet Mounting

a. The cabinet shall be mounted on the side of a pole.

b. The mounting area shall include reinforcement angle or other stiffening techniques to prevent the back of the cabinet from deforming when attached to the pole.

12. Labeling

a. The cabinet shall be furnished with a metal plate embossed with the following two (2) lines of text:

TRAFFIC CONTROL
NEW YORK CITY

Alternatively, the information noted above may be permanently etched or embossed into the cabinet door in such a manner as to be clearly visible on the exterior of the cabinet.

b. If a plate is used, it shall be 11 inches in length and 5 inches tall and welded the outside of the front door with the center of the plate located at the vertical centerline and midway between the top and the middle of the door. This plate shall be painted with the same green paint as the exterior of the cabinet. The text shall have letters that are 0.875 inch in height; the information noted above shall be embossed in a manner which allows this information to be read even after several coats of paint have been added to the cabinet. The welding for this plate shall be neat in appearance.

c. The sensor cabinet shall also be identified by model number, a serial number, and NYCDOT on a metal plate visible on the inside of the cabinet. Consecutive serial numbers shall also be stamped on the metal name identification plate and fastened to the inside of the cabinet by rivets which shall not protrude or otherwise be visible on the exterior of the cabinet.

d. NYCDOT requires that each separate procurement contract or construction contract have serial numbers which are unique and identifiable. The Contractor shall work with NYCDOT to establish a numbering scheme that allows NYCDOT and its maintenance contractors to quickly identify the specific contract which provided the controllers. This requirement shall be true for all subassemblies as well so that NYCDOT can identify the origin of the part and determine which contractor is responsible for its maintenance.

13. The sensor cabinet shall not be used for any other equipment such as data converters, transformers, etc.

C. Wireless Data Receiver and Expansion Cards

The wireless receiver and expansion cards shall be designed for mounting into a Type 170 input file rack and shall comply with NYCDOT ASTC Procurement Specification Version 2.6 Section 2.8.6.

D. Wireless Antenna for Wireless Data Receiver

The wireless antenna for the wireless data receiver shall be designed for mounting on a traffic signal, streetlight, or wood pole or a traffic signal mast arm. The antenna shall be provided as recommended by the manufacturer and as approved by the Engineer. All antenna mounting hardware shall be vandal proof and approved by the Engineer.

E. Surge Arrestor for Wireless Data Receiver

The surge arrestor for the wireless data receiver shall be provided for surface mounting inside the ASTC cabinet as approved by the Engineer. Maximum overall dimensions including fittings shall not exceed 3 in x 2.5 in x 1 in. Maximum weight shall not exceed 0.7 pounds.

2.04 ENVIRONMENTAL REQUIREMENTS

A. The design for the microwave sensor, wireless data transmitter, antenna, surge arrestor, wireless data receiver and expansion cards, and associated devices in the sensor cabinet shall meet all its specified requirements without the need to reprogram during and after being subjected to any combination of the following conditions:

1. The ambient temperature range shall be between –34 °F to +165 °F.
2. Relative humidity from 5 to 95 %, non-condensing.

B. The microwave sensor and wireless antenna shall also meet the following requirements:

1. Precipitation (rain or snow) up to 100 millimeters per hour.

2. Vibration: NEMA TS2 – 2.1.9 or approval equivalent.

3. Shock: NEMA TS2 – 2.1.10 or approval equivalent.

2.05 EQUIPMENT LABELING

A. The sensor cabinet shall also be identified by model number, a serial number and NYCDOT on a permanent metal plate visible on the inside of the cabinet. Consecutive serial numbers shall also be stamped on the metal name identification plate and fastened to the inside of the cabinet by rivets which shall not protrude or otherwise be visible on the exterior of the cabinet. Approval is required by the Engineer.

B. All equipment shall be clearly and permanently labeled as the property of NEW YORK CITY with a unique and consecutive serial number and make and model number and manufacturer's name as approved by the Engineer. These shall be visible from the exterior of the equipment and without disassembly of the unit.

C. NYCDOT requires that each separate procurement contract or construction contract have serial numbers which are unique and identifiable. The Contractor shall work with NYCDOT to establish a numbering scheme that allows NYCDOT and its maintenance contractors to quickly identify the specific contract which provided the equipment. This shall be required for all equipment furnished under this Item so that NYCDOT can identify the origin of the part and determine which contractor is responsible for its maintenance.

2.06 ELECTRICAL

A. Power Requirements

1. Microwave Sensor

   The sensor unit shall operate on 115 ± 20 VAC @ 60 Hz power and consume no more than 10 watts. Surge protection shall comply with NEMA TS2-2.1.7 & 2.1.8.

2. Sensor Cabinet

   The sensor cabinet shall be furnished with the following equipment pre-installed on the cabinet back plane.

   a. The incoming power conductors shall be terminated at a screw type terminal block with pressure pad rated for solid wire. The terminal block shall be mounted onto the aluminum back panel and shall not require encircling the wire around the screw. The screws shall be of Brass with nickel plating rated for 30 amps @ 120V and be able to accept a 2C-10B power cable.

   b. One (1) AC surge protector installed on the incoming power line. The surge protector shall be capable of reducing the effect of transient voltages applied to the AC line and provide filtering. Gas-discharge devices shall not be used in the protector. The surge protector shall be epoxy-encapsulated in a flame-retardant material and enclosed in a metal housing. The surge protector shall be wired to the load side of the circuit breaker and wiring to and from the surge protector shall be kept as short as possible.

      Normal Mode Surge Protection (Line to Neutral)

Peak Current	20 Kilo-amperes (8x20 microsecond waveshape)
Life Test	5x maximum voltage clamp change before and after 25 20 Kilo-ampere surges (8x20 millisecond waveshape)

Clamp Voltage	300 Volts Max at 20 Kilo-ampere surge; Voltage across device never exceeds 300V during surge.
Response Time	Less than 5 ns

Common Mode Surge Protection (Neutral to Earth Ground)

Clamp Voltage	700 Volts max at 20 Kilo-amperes maximum (8x20 microsecond waveshape)

Operating Characteristics

Temperature Range	-40 to +85 Celsius
Continuous Service Current	10 Amperes maximum at 120 VAC 60 Hz through series filter

MIL-STD 220 Insertion Loss Specification for Series Filter

Frequency of Applied Signal	Insertion Loss (dB)
60 Hz	0
10KHz	34
50KHz	55
100KHz	76
500KHz	76
2MHz	68
5MHz	58
10MHz	58
20MHz	63

c. One (1) AC circuit breaker rated for 15 amperes. The circuit breaker shall be an automatic trip, short delay and trip indicating type approved and listed by UL. The trip and frame size shall be plainly and permanently marked. The circuit breaker shall be a magnetic switch type breaker with overload trip point unaffected by temperature. Minimum interrupting capacity shall be 5000 amperes, RMS.

d. One (1) RS-232 serial port for connection with a laptop computer. The serial port shall be metal shell 9-pin "D" subminiature type connector with male contacts that have 15 millionths of an inch minimum gold plating in the mating area. The connector shall be equipped with two screw sockets to accept commonly used screw down retention hardware. The construction shall be such that the retention nuts which are affixed to the connectors shall not come loose or unscrew. The connector shall be electrically isolated from the power line and surge protected within the sensor unit.

The AC+ of the incoming power terminal block shall be connected to the AC circuit breaker input. The breaker load side shall feed the AC surge protector. The AC surge protector load side shall be connected to the sensor unit via an appropriately sized in-line fuse. The in-line fuse holders/fuses shall be Bussman Type HEB, 600V with type KTK fuses or approved equal. The natural and ground wires shall be connected to the AC surge protector using approved connectors. All AC and equipment ground wiring shall be bounded together using an approved connector. All internal cabinet wiring shall be rated for 30 amps and shall be approved and listed by UL. Drawings

for the cabinet equipment layout shall be submitted to the Engineer for review and approval as part of the cabinet shop drawing submission specified herein.

3. Wireless Data Receiver and Expansion Cards

   a. The wireless data receiver and expansion cards shall comply with the transient and power interruption requirements specified in NYCDOT ASTC Procurement Specification Version 2.6 Section 3.4.1.

   b. The receiver and expansion cards shall not draw more than 100 mA of current for one slot, and no more than 200 mA for two slots on the ASTC input file from the 24 VDC power supply.

   c. The receiver and expansion cards shall use the Type 170 22-Pin edge connector. Pin C on the 22-pin edge connector shall cause the unit to execute a system reset for electronics, and pins F, S, W, and Y shall be used for 4 loop emulation outputs to the ASTC controller. The remaining pins shall conform to ASTC standard for input file wiring. All outputs shall be optically isolated.

   d. In the event of an interruption in power to the sensor, transmitter, or receiver, the unit shall automatically recover within three minutes after power has been restored such that all configuration parameters are returned to their last known configuration before power disruption. No manual intervention shall be required.

B. Cables

1. Interface Cable

   a. A twenty-five (25) feet composite shielded interface cable shall be provided with each microwave sensor to provide power from the sensor cabinet to the microwave sensor unit and the RS 232 serial interface. The cable shall be designed for outside use, shall use stranded wire and shall connect the microwave sensor to the sensor cabinet with no additional splices for all project locations. All cable conductors on the non-connectorized side shall be clearly labeled and color-coded for function and voltage. Unused wires shall be clearly labeled and fully covered with a Scotch #33 electrical tape or approved equivalent.

   b. The cable shall terminate in a metal MS connector rated for outdoor usage on the sensor side. The sensor cabinet (non-connectorized) side of the cable shall be made as an assembly with a weather tight ½" connector preinstalled at the ½" connector entry point at the bottom of the sensor cabinet and the cable shall be pre-installed at the factory and terminated at respective locations inside the sensor cabinet specified elsewhere. The interface cable shall also meet the requirements as noted below. A suitable cord end connector shall be provided for cabinet entry.

2. All cables shall be of sufficient length such that the cable and connector are not strained during normal operation. Cables shall be covered with an outer jacket and shall remain flexible at all ambient temperatures.

3. All cables shall include sufficient slack to allow easy insertion and removal under adverse conditions without the need to remove other equipment to gain access to the cable.

4. All cables shall be clearly labeled and permanently affixed at the termination connector so as to clearly indicate the insertion orientation and intended socket/plug or device. Labels shall be legible and match the Contractor supplied wiring diagrams.

5. Cables shall be protected from damage caused by contact with sharp edges during shipping, servicing, and normal use.
6. Cables shall not become 'stiff' and difficult to manipulate at ambient temperatures normally experienced in New York City.
7. Cables shall be UV-resistant and provide multiple twisted pairs of stranded AWG #20 or #22 wire with a common shield rated at 300V with a temperature rating of 105 C.
8. The MS connector pins must be crimped to the cable conductors and assembled and tested prior to installation.
9. Coax Cables

   Thirty (30) feet of coax cable type LMR 400-DB or approved equal shall be provided with each microwave sensor wireless receiver and antenna. The cable shall be supplied in one length equal to the number of units on the order. Cable lengths over 100 foot shall be on a spool. A pair (2) of type N connectors shall be provided with each 30 foot length of cable and the connectors shall be uninstalled. The connectors shall be of the crimp type requiring solder free installation. The connectors shall be Times micro wave part number EZ -400-NMH-D or approved equal using a hex crimper with a diameter of 00.049 crimping die and not requiring crimping of the center conductor pin of the connector. Each 30 foot cable assembly shall be provided with one (1) cord end connector for pole entry type Hubbell/Kellems SHC1023 Strain Relief Cord Connector or approved equal.

C. Printed Circuit Board (PCB)

All printed circuit wiring shall be protected from damage which might be caused by short circuits in the field wiring, overloads, insertion and removal of assemblies and subassemblies, water entry to the cabinet, moisture, and defective components. Under no circumstances shall any field wiring error, equipment failure or other circuit failure cause damage to the current traces or connections on any printed circuit board. Special attention must be paid to all connectors and traces used for low current monitoring to ensure that printed circuit wiring cannot be damaged. The Contractor shall ensure that the conformal coating and masking are such that moisture cannot induce damage to the printed circuit wiring. All printed circuit boards shall meet the following requirements to enhance reliability:

1. All plated-through holes and exposed circuit traces shall be plated with solder.
2. Both sides of the printed circuit board shall be covered with a solder mask material.
3. The circuit reference designation for all components and the polarity of all capacitors and diodes shall be clearly marked adjacent to the component. Pin #1 for all integrated circuit packages shall be designated on both sides of all printed circuit boards.
4. All electrical mating surfaces shall be gold plated.
5. All printed circuit board assemblies shall be coated on both sides with a clear moisture-proof and fungus-proof sealant with a UV tracer.
6. All components and wire harnesses shall be mounted to the PCB using plated holes. "Piggy back" connections or jumper wires shall not be acceptable.

END OF SECTION

SECTION 16793

FURNISH AND INSTALL MICROWAVE SENSOR ASSEMBLY

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

All drawings shall not exceed 11"x17" and shall foldout where required. An electronic version of the drawings shall be provided on a Compact Disk (CD) based on AutoCAD 2000 (or latest version) application software for a personal computer.

1. Sensor cabinet equipment layout details.
2. Drawings detailing typical placement of each sensor at all structure mounting and aiming configurations and showing the proposed height the unit is mounted at, the proposed detection zone and hardware mounting methods.
3. Typical installation details of the interface cable from the sensor to the sensor cabinet, including the RS-232 and contact closure output terminations.
4. Typical installation details of the wireless data receiver and associated equipment at the ASTC cabinet..

B. Samples

Three (3) randomly selected samples shall be delivered for inspection and testing within forty-five (45) consecutive calendar days after notice from the Authority and upon receipt of this notice, the Contractor shall also submit six (6) complete sets of working drawings to the Engineer. Failure to submit the samples and drawings within the time specified will be sufficient reason to declare the Contractor not in compliance and ineligible for award of Contract.

C. Product Data

The Contractor shall submit the manufacturer names, equipment model numbers, catalog cut sheets, and other descriptive materials for all equipment and components proposed under this pay item prior to the purchase for approval by the Engineer.

D. Manuals, Warranties/Guarantees

The Contractor shall provide complete maintenance and operation manual, which includes schematics, component layout, bill of materials with generic manufacturer's part numbers, assembly and disassembly instructions, calibration procedures, exploded assembly drawings, protocol documentation, and complete instructions for the installation and use of the laptop PC setup and calibration procedures. Documentation shall be bound.

E. Qualifications

Prior to commencing work on this item, the Contractor shall provide the Engineer with evidence of the microwave sensor manufacturer either having provided at least three successful detector installations of fifty or more sensors identical to the model proposed in an operational system of similar scope over three (3) years, or the experience of comparable system complexity as judged by the Engineer. The submittal shall include the names and phone numbers of users familiar with the installations.

F. Training

The Contractor shall provide training courses at a location in New York City to be designated by the Engineer over a 1-day period of 7 hours for two (2) identical training sessions. Each of the training sessions shall accommodate up to 10 people. Qualified representatives of the Contractor and sensor manufacturer shall teach the course.. The course shall cover all aspects of sensor mounting, configuration, operation and maintenance with hands on demonstration of all topics using actual sensors and test equipment. The Contractor shall furnish all course materials for each individual and supply all necessary demonstration sensor and test equipment for the course. A course outline shall be furnished to the Engineer for approval 30 days prior to the start of the course.

END OF APPENDIX "A"

DIVISION 16

SECTION 16860

ELECTRIC HEATERS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for electric heaters.

B. Types of electric heaters specified in this Section are:

1. Horizontal unit heaters
2. Fan forced wall heaters
3. Wall mounted explosion resistant convectors
4. Baseboard heaters

1.02 REFERENCES

American National Standard Institute (ANSI)

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

National Electric Code (NEC)

National Fire Protection Agency (NFPA)

Occupational Safety & Health Association (OSHA)

Occupational Safety & Health Association (OSHA)

Anti-Friction Bearing Manufacturers Association (AFBMA)

Anti-Friction Bearing Manufacturers Association (AFBMA)

American National Standard Institute (ANSI)

Air-Conditioning and Refrigeration Institute (ARI)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. The electric heaters shall be designed, manufactured and installed in accordance with the latest revision of applicable standards referenced in 1.02. In case of conflict between various standards, the more stringent requirement shall apply.

B. Design and performance requirements of electric heaters shall be as specified in the "Electric Heater Schedule", shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

A. Electric heaters of type and sizes required, shall have been satisfactory used for the purposes similar to those herein, for not less than three years.

B. Electric heaters shall be subject to factory inspection prior to shipping.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver heaters with factory-installed wooden skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle heaters carefully to avoid damage to components, enclosures and finish.

C. Store heaters in clean dry spaces and protect them from weather.

D. Touch up any damage to finishes to match adjacent surfaces.

E. Comply with the manufacturer's instructions for unloading and moving heaters to their final locations for installation.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide electric heaters of the manufacturers listed on the Contract Drawings.

2.02 CONSTRUCTION FEATURES

A. General

Electric heaters shall consist of casing, electric heating elements, fan, motor and drive (if required), control equipment, power and control wiring, enclosures, pedestal legs, discharge grille, blank section and accessories etc., as specified herein and as shown on the "Electric Heater Schedule" shown on the Contract Drawings.

B. Horizontal Unit Heaters

1. The cabinet shall be made of 18-gauge die formed, furniture grade steel. The housing shall include individual adjustable louvers with 30 degree downward stops shall be furnished to provide desired control of discharge air. All metal surfaces of the casing shall be phosphate coated to resist corrosion and finished in baked enamel. Mounting brackets designed for ceiling mounting shall be furnished.

2. Heaters to be of the draw-through air flow design to eliminate hot spots and extend design life.

3. For safety, the electric heating bank shall consist of metal sheath heating elements. The elements shall have a copper clad steel sheath for strength and corrosion resistance and aluminum fins for faster heat transfer. Automatic reset thermal overheat protection shall be of the linear capillary type wired for instantaneous de-energizing in case of thermal overload. Heating bank to have protective air inlet louvers.

4. Motors shall be of the totally enclosed, continuous heavy-duty all-angle operation equipped with built-in thermal overload protection.

5. Fans shall be aluminum and with fan delay, directly connected to fan motor, designed specifically for unit heater application.

6. Low voltage control transformer and thermostat shall be provided, for more precise temperature control.

7. All horizontal unit heaters shall be provided with factory installed disconnect switches.

C. Fan Forced Wall Heaters

1. The cabinet shall be made of heavy-duty, 16-gauge steel bar grille with bronze brown baked enamel finish and aluminum frame.

2. The electric heating elements shall be steel finned metal sheath with low sheath temperatures. Built-in power disconnect switch shall be provided for added safety during maintenance.

3. Heater shall be wired with standard 60 degree C.(166 degree F) wire.

4. Automatic reset thermal overheat protector disconnecting power in event of overheating due to accidental blockage shall be provided.

5. Heater shall be equipped with integral thermostat for quick installation. Tamper-resistant, adjustable through the front bar grille of heater.

6. Fan shall be aluminum, directly connected to fan motor. Motor shall be permanently lubricated and totally enclosed, for long life and low maintenance.

7. Built-in fan delay switch energizes fan motor only after the element are heated. When heat shuts off, the fan delay switch de-energizes fan motor after residual heat gas been dissipated.

D. Wall-Mounted Explosion-Resistant Convector

1. The housing shall be made of heavy-gauge steel with baked neutral gray enamel finish and integral mounting brackets.

2. The heating element shall be long, low-watt density element with steel sheath and brazed steel fins, supported by sturdy steel framework.

3. An explosion-resistant external wiring connection for 3/4" conduit shall be furnished within the convector enclosure.

4. A separate, wall mounted explosion resistant thermostat (40°F-80°F range) shall be provided.

E. Electric Baseboard Heaters

1. Heaters shall be low profile and available in lengths from 28 inches through 10 feet.

2. Heating elements shall be made of aluminum. Low-density elements shall be installed side-by-side on the same horizontal plane to uniformly warm all incoming air. Elements shall be center-anchored and shall float freely on each end through nylon bushings.

3. Built-in controls shall include thermostats, disconnect switch, transformer relay and power relay. The thermostat shall be capable of controlling multiple units on a pilot duty circuit. Thermostat adjustment shall be with thin bladed screwdriver through the discharge louvers and shall be tamper-resistant.

4. An automatic reset thermal overheat protector shall run the full length of the heater and shall turn off heating elements, should overheating occur at any point along heating length. Overheat protector shall restore operation automatically when the cause of overheating is removed.

5. Heaters shall be designed with a built-in pre-wired raceway to enable multiple-unit wiring from one feeder source.

6. Enclosures shall be 14-gauge aluminum with reinforced, all welded construction designed to withstand heavy-duty commercial and institutional use, with extruded aluminum pedestal legs.

7. Top discharge grille shall be extruded aluminum with anodized finishes. Heaters shall be designed so that front covers can be easily removed for individual servicing in a wall-to-wall run.

8. A 1/4-inch mesh aluminum screen shall be installed beneath the discharge grille to deter the insertion of foreign objects.

9. Back panel shall be one-piece painted steel, completely finished, and shall be suitable for mounting in front of a glass curtain wall.

10. Heaters and blank sections shall be designed so they can be butted together with use of splice plates.

11. Accessories shall include end caps, blank sections and splice plates. Blank sections shall be completely enclosed to enable the installer to pull standard wiring from heater to heater through the accessories.

2.03 SHOP TEST

Verify that manufacturer has tested each electric heater and certified its rating and its completeness.

PART 3. EXECUTION

3.01 EXAMINATION

Report immediately to the Engineer any electrical, structural or related construction defects in areas where electric heaters are to be installed. Do not attempt to rectify any defect, unless specifically instructed to do so by the Engineer.

3.02 PREPARATION

Before installation of electric heaters, the Contractor shall investigate the site condition to determine, what preparatory work, if any, will be needed.

3.03 INSTALLATION

A. Install electric heaters in accordance with manufacturer's installation procedures, as shown on the Contract Drawings and in accordance with the following:

1. Fan forced wall heaters shall be installed a minimum of 12" from floor or 8" from adjacent wall surface, behind door, upside down or side-up, in floor, ceiling or closet.

2. Wall-mounted explosion-resistant convectors shall be installed a minimum of 24 inches above finished floor.

3. Horizontal unit heaters shall be mounted a maximum of 20 feet above finish floor.

B. Coordinate all trades to ensure that the installation of the units is not in conflict with the work performed by other trades.

C. Verify the electrical wiring installation is in accordance with manufacturer's submittal and in accordance with the installation requirements of other electrical Section(s) of the Specifications.

3.04 FIELD TEST

Start up, test and adjust units in presence and to the satisfaction of the Engineer.

END OF SECTION

SECTION 16860

ELECTRIC HEATERS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

Shop Drawings

16860A01 Shop drawings.
a. Layout drawings layout, type and locations of electrical heaters.
b. Electrical and control wiring diagram.

Catalog Cuts

16860B01 Catalog Cuts cuts, which shall include but not be limited to the following:
a. Design and performance data for heating capacity;
b. Electrical characteristics;
c. Accessories.
d. Unit construction components, materials and gauges.
e. Control equipment data.
f. Installation procedures.

Manufacturer Test Reports

16860F01 Shop test data -Submit 12 copies of shop test data and manufacturer's certification.

Calculations

16860H01 Calculations -Submit calculations for the room heating requirements

Manuals, Warrantees/Guarantees

16860I01 Submit 12 copies of operation and maintenance manuals including replacement and spare parts list.

END OF APPENDIX "A"

DIVISION 16

SECTION 16936

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM (FOR BAYONNE BRIDGE SYSTEMS)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for hardware, software, operations and training for a supervisory control and data acquisition (SCADA) system for the Bayonne Bridge Systems.

B. Related Work specified in other Sections of the Specifications includes the following:

1. Section 16000 – Electrical General Requirements
2. Section 16110 – Raceways
3. Section 16120 – Wires, Cables, Splices, Terminations 600 Volts or Less
4. Section 16127 – Control/Signal Transmission Media
5. Section 16133 – Control Panels, Enclosures/Cabinets and Terminal Boxes
6. Section 16135 – Boxes and Fittings
7. Section 16150 – Motor Power and Control Wiring
8. Section 16190 – Supporting Devices
9. Section 16450 – Grounding

1.02 SYSTEM DESCRIPTION

A. The following major systems are to be monitored and controlled by the SCADA system and viewable on SCADA workstations via the SCADA software:

1. Power Distribution System
2. Emergency Generators
3. Uninterruptable Power supplies
4. DC Battery Chargers and ground Fault
5. Bridge Fire Pumps and Standpipe
6. Bridge Lighting Systems
7. Fire Alarm Systems

8. Building Management System
9. Hazardous Material Storage
10. Sump Pumps
11. SCADA communications monitoring
12. PLC Hardware Failure.

B. Develop and supply the SCADA system to operate according to the parameters outlined in this specification section.

C. The Contractor is responsible for providing the custom application software, startup and full functional testing of the system.

D. The Contractor is responsible for the configuration of the communications network per the manufacturer's wiring standards.

E. The Contractor is responsible for all HMI graphics for each SCADA building as well as the redundant HMI computers within the M/E Buildings.

F. Provide Labor for the configuration and testing of the application software. This includes all relevant items in this specification.

G. Supply all versions of PLC code, HMI code, and system documentation and installing in software application.

H. The Contractor shall provide a contingency plan developed so that recovery procedures are available if data is modified or destroyed, or if the integrity of a system is suspect.

I. The Contractor shall provide a contingency plan that covers emergency response control, back-up operations, and post-disaster recovery, addresses control during natural disasters and malicious actions.

J. The Contractor shall dispose of all electronic waste, particularly batteries, in accordance with city, state and federal laws and guidelines and as dictated in the Contract documents.

1.03 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C37.90	Relays and Relay Systems Associated with Electric Power Apparatus
ANSI C62.41	Guide for Surge Voltages in Low-Voltage AC Power Circuits
ANSI 730	Definition, Specification, and Analysis of Systems Used for Supervisory, Data Acquisition, and Automatic Control
ANSI 829	Software Test Documentation
	New York City Building Code (NYCBC)
	National Fire Protection Association. (NFPA)
NFPA 70	National Electric Code
NFPA 75	Protection of Electronic Computer/Data Processing Equipment
NFPA 502	Standard for Road Tunnels, Bridges, and Other Limited Access

	Highways
	Underwriter Laboratories (UL)
UL 497	Protectors for Paired Conductor Communication Circuits
UL508	Industrial Control Equipment
UL1053	Safety for Ground-Fault Sensing and Relaying Equipment

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Reliability: The SCADA system shall be a fault-tolerant system such that any one system component failure or network failure shall not affect the full system operation. Redundancy shall be implemented at all levels of network. Redundancy software shall be implemented so that there shall not be any loss of information in case of changeover from master system to standby system. Seamless switchover shall be provided for switching of SCADA Servers, Programmable Logic Controllers, remote input/output modules so that there is no loss of data or change in state during switchover or failover or equipment.

B. The SCADA system and instrumentation subsystems shall be configured as a distributed processing network with two (2) servers operating in a hot standby configuration and multiple workstations performing the functions of the operator interface.

C. The operation of equipment shall be subject to operational modes, conditions, logic and sequences described in this Section and other support documents, as well as the existing SCADA and PLC programs.

D. The SCADA system shall have logging and reporting capabilities that will assist in ongoing operation and maintenance activities.

E. All SCADA products shall be manufactured by the same manufacturer.

F. The SCADA shall be designed for full time, 24 hour, 7 day a week operation of critical bridge sub-systems, including life safety systems. The system design, hardware and software utilized shall be such that no single point of failure of the Host Servers, Workstations, communications, RCU's and other intelligent field processor equipment or input power shall disable any of the defined real-time functions. Devices shall be re-configurable to maintain bridge facility operations during any failure and during normal maintenance of the hardware and software.

G. All SCADA components shall be of the most highly developed technology currently available and in a state of common usage, in manufacturer and performance.

H. All SCADA equipment shall utilize standard, commercially available products.

I. The system shall include all necessary components and software required to make a complete and operable system.

J. All software products which are not site specific, or otherwise specified commercially available software packages (such as the operating system, spreadsheets, word processing program, etc.) shall be manufactured by the SCADA manufacturer, as part of their standard product offering and shall not be custom produced for this application. This standard product software shall be modular in structure, enabling future system upgrades for additional capabilities to be easily accomplished, by installation of specific subroutines without requiring modification of the existing system configuration.

K. The SCADA hardware and software shall support Open Systems Architecture.

L. All control instruments, such as pressure switches, temperature switches, etc., shall be wired in fail-safe mode, such that the relay is energized under a normal condition and de-energized under an alarm condition.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Operating Temperature: 0°C to 60°C (32°F to 140°F).

B. Storage Temperature: -40°C to 70°C (-40°F to 158°F).

C. Relative Humidity: 5% to 95% non-condensing.

D. Vibration: Sinusoidal, IEC 68-2-6, Test Fc; 0.15 mm peak to peak, 10-57 Hz; 1.0 g, 57-150 Hz.

E. Electromagnetic Compatibility: EN 50081-2:-1993 and EN 50082-2:.1995 compliant.

1.06 QUALITY ASSURANCE

A. Control components shall be state-of-the-art, manufactured by companies specializing in control systems and devices.

B. Control system shall be pre-wired and pre-tested in the shop.

C. Field wiring and installation of control systems shall be limited to connecting remote mounted components to the terminals in the control panel.

D. Field test of the control system shall be performed by the Contractor.

E. All components shall bear the UL label.

F. Manufacturer Qualifications:

1. The control and communication equipment to be furnished under this Contract shall be the standard products of a firm established in the production and installation of such equipment. The manufacturer and products shall meet the following requirements as a minimum:

a. The manufacturer shall have successfully produced and installed complete microprocessor-based monitoring and control systems for five (5) years, and shall have shown high commitment to product, manufacturing and design process quality by having attained and maintained ISO9000 registration.

b. The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance. A toll-free (800) number hot-line shall be available for emergency support.

c. Have three (3) or more installed operational microprocessor-based monitoring and control systems, equivalent in size and complexity to the system to be furnished under this Contract and each shall have been in continuous satisfactory operation for a minimum of one (1) year.

2. The PLC Hardware and Software manufacturer shall have available within the New York Metropolitan Area a network of certified equipment vendors and system integrators, consisting of at least three different, independent entities, who can provide hardware and software support for the RCU's installed under this Contract. Proprietary systems with hardware availability or software support from only a single source or entity shall not be utilized. The hardware and software installed as Work of this Contract shall allow the Authority, if it so chooses, to expand the RCU's or make system modifications (such as adding hardware, I/O points, creating or modifying graphic screens or control routines, etc.) under the Work of future Authority Contracts to be performed by others, without having to Sole Source said Work to the Contractor, installer or System Integrator of this Contract.

3. The Contractor shall submit in writing the identification of the control system manufacturer(s) and the specific products to be furnished for this system along with certification that the product family has a five (5) year history. The Contractor shall provide the names, addresses and telephone numbers of the operating personnel who can be contacted regarding these control systems.

4. The Contractor shall arrange an inspection of one of the installed systems upon request. The system submitted for this demonstration shall meet the requirements specified herein.

5. The Software manufacturer shall have training available from one or more manufacturer-approved training groups or companies in the New York City area, including technical support available for purchase from the software manufacturer or distributors.

G. Installer Qualifications

1. The Systems Integrator and Installer shall furnish all specified components, shall be of established reputation and experience in the field of SCADA Systems, and shall be qualified by the manufacturers of the proposed equipment to install, service and maintain each manufacturer's equipment.

a. The Systems Integrator and Installer shall furnish all specified components, shall be of established reputation and experience in the field of SCADA Systems, and shall be qualified by the manufacturers of the proposed equipment to install, service and maintain each manufacturer's equipment

b. The Systems Integrator and Installer shall serve as the single point of responsibility for the work described in this Section.

2. Retain the services of personnel certified by the equipment manufacturer to: assist in the installation of the equipment; check the installation before the equipment is placed into operation; assist in the performance of field tests; assist in the hardware configuration, and train the Authority operations and maintenance staff in the care, operation, troubleshooting and maintenance of the equipment.

a. Unless otherwise authorized by the Engineer, the certified personnel shall have at least 7 years experience and an in-depth knowledge of the equipment to be used in the installation, testing, and start-up of the equipment under this Section. The Manufacturer's sales and marketing personnel will not be accepted as Manufacturer's Representatives

1.07 DELIVERY, STORAGE, AND HANDLING

A. Materials and equipment which are not immediately installed after delivery to construction site shall be carefully stored in a dry and clean space. Close exposed parts of the work with temporary covers or plugs during construction to prevent entry of moisture or obstructing materials.

B. Protect all equipment against damage during transit and storage. All equipment shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage during transportation.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer. Product name, Port Authority Contract and Work Order Number (as applicable); storage requirements and any other special handling instructions.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, weather, temperature, corrosion, contaminants, dirt, vandalism or other causes.

E. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-site location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment form the off-site storage facility to the Work site as well as proper storage, handling and security of the equipment at the off-site storage location.

F. After delivery at the work site, a field inspection of the equipment will be made by the Contractor in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the equipment shall be installed by the Contractor.

1.08 GUARANTEES

A. Furnish a minimum 1 year manufacturer's replacement warranty for all devices and equipment. All devices shall have a warranty against defects in materials and workmanship for a one-year period commencing on the Base Date and ending on the first anniversary of the Base Date. (Base Date is defined to be the day of Authority's acceptance of the completion of the 30-day Operational Testing specified herein). The warranty shall cover all components, parts, installations, and assemblies. The warranty shall cover labor to trouble shoot, repair, reprogram, replace defective components, and travel to and from the location where the equipment resides.

B. All SCADA equipment and hardware shall have a minimum life cycle expectancy of 10 years.

1.09 MAINTENANCE

A. Owner's Manual/Maintenance Instructions

B. Extra Materials / or Spare Parts

1. Each PLC shall have 60% spare memory on the back plane and 25% spare I/O on each PLC used in the complete system.
2. All RCU and RIO cabinets shall be supplied with a minimum of one free expansion slot.

1.10 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, unless otherwise noted furnish and install products of one of the following, or approved equal: Siemens, Allen Bradley, GE.

2.02 MATERIALS

A. SCADA Servers

1. Shall be Lenovo/IBM scaled according to the application requirements of this section.
2. The SCADA Server shall be provided to support the SCADA system application software and database and shall meet the following requirements as a minimum;
   a. Quad Core Xeon E5450 Processor2x6MB Cache, 3.0GHz, 1333MHz FSB

b. 32GB 667MHz (8x4GB), Dual Ranked DIMMs.

c. Windows Server® 2008 Enterprise Edition, Standard x64 installed

d. PERC6i SAS RAID Controller, 2x4 Connectors, Int, PCIe, 256MB cache, x6

e. Bkpl. (RAID 5 Database, RAID 0 O.S)

f. 1x6 Backplane for 3.5-inch Hard Drives

g. Hard Drive configuration; Integrated SAS/SATA, SAS 6/iR Integrated.

h. (2) 500GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Primary Hard Drives

i. Video Card Riser with 2 PCI-X Slots (3 Volts) and 1 PCIe Slot

j. Dual Embedded Broadcom® NetXtreme II 5708 Gigabit Ethernet NIC

k. 24X IDE CD-RW/DVD ROM Drive

l. Keyboard and Optical Mouse, USB, Black, Wnglish l.19 inch Widescreen Analog LCD Panel Display

m. Universal Rack Rails for Vertical rack mounting

3. Server Operating System software

a. Latest editions of Windows Server® 2008 Enterprise Edition and all later source patches issued by Microsoft and certified for use by the SCADA application software.

b. Licensing to support the SCADA application software.

4. All Server Hardware shall be procured by the Technology Service Department.

B. SCADA Rack Mounted Laptops

1. Manufacturer: Lenovo/IBM Scaled according to the application requirements of this Section.

2. SCADA Rack mounted laptop shall be provided in locations as noted on drawings and shall meet the following requirements as a minimum:

a. Intel® Quad Core Xeon Proc E5450, 3.0GHz,2X6MB L2 Cache,1333MHz b. b. (1) 22 inch Widescreen Analog Flat Panel Displays

b. 4GB, DDR2 ECC SDRAM Memory 667MHz, 4X1GB

c. Dual Drives: 16X (DVD+/-RW) Burner and 48X CD Burner/DVD Combo

d. nVidia Quadro FX 4600 768MB dual VGA or DVI video card f. 250GB SATA 3.0Gb/s with NCQ and 8MB DataBurst Cache

e. Integrated PCIe Gb NIC Ethernet

f. USB Keyboard and Mouse Black, English

3. Operating System Software

a. Furnish latest release of Windows XP Service Pack 3, and all later source patches issued by Microsoft and certified for use by the SCADA System Application Software, as required for the support of the SCADA Systems Fully Redundant solution and networked attached storage solution.

4. All required licenses and application software for complete operation of the system from shall be loaded and provided for each laptop.

5. All Laptop Hardware shall be procured by the Technology Service Department.

C. Remote Control Units (RCU)

1. Each RCU cabinet shall contain a programmable logic controller (PLC) as indicated on the contract drawings. The PLC shall be an industrial-grade, microprocessor-based unit, meeting the following requirements:

a. All PLC's shall have port to communicate via Ethernet/IP RJ45 and Fiber Optic Connection. All scaling of values to engineering units shall be accomplished within the PLC, not the HMI.

b. PLCs shall support Network Time Protocol to synchronize time.

c. Single loop controllers shall NOT be used. All loop control shall be performed in the PLC logic.

d. Each Programmable Logic Control shall consist of centralized processing unit (CPU) modules, synchronization modules and communication modules. The PLC shall be suitable for hardware and firmware redundancy configuration system.

e. Each CPU shall be a high-availability programmable controller designed for redundancy and fault tolerance system. The CPU shall carry out extensive self-tests and report all problems:

(1) The link between the central controllers.

(2) The CPUs.

(3) Other Processors.

(4) Memory.

(5) Cyclic self test to checksum errors.

(a.) The following reporting functions shall be provided by the CPU:

i. Status and error displays: LEDs indicate internal and external errors and operating states such as RUN, STOP, Restart, "Master" operating modes.

ii. Test functions: signal states in the program sequence can be displayed, process variables changed independently of the user program, stack memory contents output, program steps run through individually and program sections blocked.

iii. Information functions: the programming device can be used to provide the user with information about the memory capacity and operating mode of the CPU, as well as on the user RAM and load memory currently in use.

(b.) The CPU shall have the capability of addressing up to at least 131,072 digital input/out channels and 8,192 analog input/output channels. It shall also have the ability to communicate with at least eight remote locations.

(c.) The memory for each system shall be expandable with the addition of RAM memory sub-modules.

(d.) Each CPU in the PLC shall have the following minimum configuration:

i. 16 MB user memory.

ii. 64 MB RAM.

iii. Real time clock.

iv. Time of day synchronization.

v. 8 KB process image.

(e.) The CPU for each system shall be capable of floating point math calculations including integer to floating point conversion, floating point to integer conversion, add, subtract, multiply, divide, square root, and compare.

2. Each RCU cabinet shall be configured as follows:

a. Two redundant PLCs shall be provided for each M/E Building and shall run identical software. The standby PLC's data shall be updated every scan. On failure of the on-line PLC, the standby PLC shall take control within 50 milliseconds. The transfer from primary to back up must be bumpless with no loss of control. At changeover, all I/O shall be transferred to the standby PLC and the system shall maintain communications with all I/O, HMI and SCADA Servers. Provide synchronization modules for each system to keep the data in both CPUs in synchronization. Connect the two synchronization modules with two single mode optical fiber cables with diverse routes. Program PLC to detect and alarm on failure of a synch cable. Hot backup configuration transfers, e.g., failover, shall be engineered into the PLC operating system by the PLC manufacturer, not by the Installation Contractor.

b. One PLC shall be provided for each Tower room location. On failure of the PLC, the SCADA Server shall generate an immediate failure alarm.

c. Each RCU PLC shall allow independent equipment operation within the building. Each RCU PLC shall also be capable of exchanging information both with each other on a peer-to-peer level and with the remotely located SCADA Servers.

d. Remote I/O bases interfacing to single field devices shall be used. At changeover, all I/O shall be transferred to the standby PLC and the system shall maintain communications.

e. Loss of communication with the SCADA servers shall not compromise system operation. The PLCs shall continue to operate in the last command sent from the SCADA workstations if the communication link between the PLC and SCADA workstation is disrupted.

f. The design of the PLC must result in an availability rate of 99.99%. The Contractor will be required to furnish hardware and software documentation from the manufacturer which will meet or exceed this availability rate for the PLC equipment supplied.

g. As a minimum the processor and power supply redundancy shall be tested by removing power for the primary processor and power supply and checking that the system remains operational.

h. All SCADA equipment shall be fully tested with all communications paths operational.

3. The software of each PLC located in each RCU cabinet shall be configured as follows:

a. Program functions for each system shall include Sequential Function Chart (SFC), contacts, coils, timers, counters, math functions (add, subtract, multiply, divide), shift registers, bit, and word operations.

b. Programming Tools

(1) Integrated software packages shall provide programming, troubleshooting and documentation capabilities. These software packages shall be able to run on a variety of hardware bases. These software packages shall support ladder logic, a high-level language with analog alarming capability.

(2) Programming tools shall support both off-line and on-line programming in addition to the ability to obtain a hard copy print of all programming and configuration.

(3) There shall be provisions for connection to a local area network (LAN) allowing remote programming of any PLC on the network.

c. Other Relay Ladder Instructions

(1) There shall exist instructions which shall skip any number of ladder logic rungs to a specified rung. There shall also exist an end program instruction to skip all unprogrammed lines in memory.

(2) Instructions shall be present to set time and date and to compare time and date. There shall exist discrete and motor alarm timer instructions that shall use a feedback loop to confirm control action occurrence. In the event control actions do not occur in the desired time, an alarm bit shall be set.

(3) High-level instructions shall provide Boolean word operations of AND, OR, exclusive OR and comparison. Instructions to perform bit manipulation of user memory (bit set, clear, pick, etc.) shall be available for user programming. I/O register, word and table instructions shall be provided which include moves to and from tables, AND's, OR's, complement, compare, search, indirect addressing and RLL subroutines.

(4) Ladder logic documentation shall consist of one comment block for each output coil and a synonym for each contact or output coil. The I/O documentation shall display on a base-by-base basis what type module is in each slot and the synonym for each I/O point. All documentation shall be able to be printed out for reference (Variable and Constant memory documentation, program title).

D. Remote Input/Output Units (RIO)

1. Remote I/O rack shall be produced by the same manufacturer of the PLC's.

2. Remote I/O (RIO) shall have dedicated power and communications modules.

3. Remote I/O modules shall be provided for all input and output modules for each system. The minimum quantities of Remote I/O modules are shown on Drawings. Provide additional Remote I/O to suit the final configuration required by the SCADA system, and spares as follows:

   a. Each I/O panel shall have 25% spare I/O for each type of digital, analog and input and output.

   b. All I/O racks shall be supplied with a minimum of one free expansion slot.

4. The Remote I/O modules shall have the following configuration:

   a. Provide communication processors for optical fiber cables.

   b. Self diagnoses on module faults, short circuits, bus errors, power supply failure, and plugging and removal of I/O modules.

   c. Inputs and outputs for each system shall be modular. Each module shall have status LEDs for each point. All field wiring shall be terminated to a removable terminal block that shall permit prewiring of the module, or removal and replacement of a module without disturbing the field wiring or any other I/O modules. All I/O modules shall be firmly attached to the I/O chassis. In order to preserve space and chassis slot available for future points, for module of equal size, select the one having maximum quantity of points. Where 4 points and 8 points modules are both available, use 8 points module card.

   d. Digital input and output modules for each system shall have minimum 16 isolated circuits per module.

   e. The I/O shall be configured for last state in the event of a compromise in system operation due to loss of communication, backplane power, or processor fault.

   f. Input and output modules for each system shall have faceplates that shall be marked or labeled in accordance with the Drawings and points list.

5. Hermetically sealed interposing relays within the PLC shall be provided between digital outputs and electrical equipment. The relays shall be either base mounted plug in types, or modular DIN rail mounted. Output relay contacts for 125 VDC controlled switchgear shall be rated at not less than 10 ampere with a 20 ms time constant inductive load.

6. The I/O rack hardware shall have a high degree of reliability in the hardware design. It is expected that a loss of a circuit, end device, fuse, etc. will not jeopardize the operation of the rest of the components at the I/O location.

E. SCADA Software Requirements

1. Each piece of software developed or modified for this project shall be written in a commercially available off the shelf (COTS) development environment. The language compiler shall conform to the latest specifications of the American National Standards Institute (ANSI).

2. Interfaces to and between various manufacturers' software package shall be provided through industry standard application program interfaces (APIs). All software shall be constructed with modular device driver interfaces, and shall employ standard I/O system, operating system, file system, and database management system calls to facilitate migration to new versions of system software.

3. Software licenses shall be provided for each piece of software. The types of licenses provided:

   a. Shall be perpetual.

   b. Shall allow the SCADA System to operate as designed.

   c. Shall allow a third party contracted by the engineer to modify, update, and extend the software and/or the system configuration, including adding display elements.

4. The software graphics system platform shall be proposed by the Contractor and submitted for approval.

   a. The graphics software package shall be service-proven SCADA HMI software. Software that has been in service for no less than 3 years in no fewer than two other comparable environments shall be considered service proven SCADA HMI software.

   b. The graphics package shall have the capability to develop process schematics and screens. The screens shall dynamically update important and crucial real time process parameters at suitable locations on the Workstation or HMI screen.

   c. The developmental packages shall be furnished by the Contractor and licensed to Port Authority. A minimum of two (2) software development packages and two (2) user licenses shall be provided. The development package shall include all tools and features required to modify, create and install graphical displays and control windows.

5. Software Configuration and Development Tools

   a. Integrated software packages shall be available to provide configuration, troubleshooting and documentation capabilities.

   b. Software packages shall be capable of running a variety of hardware bases.

   c. Software packages shall support ladder logic, a high-level language with analog alarming capability.

   d. Programming tools shall support both off-line and on-line programming in addition to the ability to obtain a hard copy print of all programming and configuration.

   e. There shall be provisions for connection to a local area network (LAN) allowing remote programming of any PLC on the network.

   f. Software development packages shall be provided on DVD or CD ROM with detailed installation and uninstall documentation. An install shield program with uninstall shall be provided. The Contractor shall preinstall one copy of the developmental package onto one of the SCADA Workstations in the NY M/E Building and the NJ M/E Building.

F. SCADA HMI Screen Requirements

1. Refer to Appendix B for Bayonne Bridge Sample SCADA Screens.

2. The Contractor shall develop and configure SCADA Screens to represent all data points available to the SCADA system. The SCADA Screen operation shall be configured to provide the following operation:

   a. Single click operation to navigate between screens

   b. Visible time and date information on all screens

   c. Graphical indication of alarm conditions using text, icons an color changes.

   d. Single click operation to a "Home" or "Main" screen available on any screen.

   e. Pop up confirmation of action prior to executing a command that will activate operation of mechanical or electrical equipment.

3. The Contractor shall provide a minimum of twenty (20) separate user defined screens, including but not limited to the following:

   a. Bayonne Bridge System Status

   b. Bayonne Bridge Location Status

   c. Bayonne Bridge Power Distribution System

   d. Bayonne Bridge UPS& Batteries

   e. Bayonne Bridge Roadway Lighting

   f. Bayonne Bridge Generators

   g. Bayonne Bridge Building Management System

   h. Bayonne Bridge Fire Alarm

   i. Bayonne Bridge Aesthetic Lighting

   j. Bayonne Bridge Standpipe

   k. Bayonne Bridge Admin Building/Hazardous Materials Store

   l. Bayonne Bridge SCADA System Status

   m. Bayonne Bridge Alarm Log

G. SCADA Software Alarm Functionality

1. The SCADA system software shall have a consistent alarm management configuration with alarms separated into classes depending on how they relate to safety and the process as follows:

   a. A minor alarm shall be a warning notification prior to reaching a major alarm status. Minor alarms are intended to notify operators that a process is out of its normal operating range and provide an opportunity to deal with the situation when the operator is available to do so. Minor alarms shall be assigned as Class 3 alarms.

b. A major alarm shall be a warning notification prior to reaching critical alarm status. Major alarms are intended to notify operators that a process is out of its normal operating range and the condition requires immediate attention. An example of a major alarm would be a pump does not enter the run condition when a start command is issued from the SCADA. Major alarms shall be assigned as Class 2 alarms.

c. A critical alarm shall be a warning notification of a catastrophic event that has reduced the reliability and availability of the system. Critical alarms are intended to notify operators that an issue exists which could jeopardize the system and the condition requires immediate attention. An example of a critical alarm would be a backup PLC is not available at a location. Critical alarms shall be assigned as Class 1 alarms. Class 1 alarms shall be viewable at all SCADA workstations and SCADA Building HMI panels.

d. The alarms associated with the uninstalled equipment shall be disabled until that equipment is installed and tested.

2. At a minimum, the following minor alarms (Class 3) shall be generated.

a. Intermittent SCADA communication.

b. Loss of RIO module communications.

c. Door switch opened < 5 minutes (adj.).

3. At a minimum, the following major alarms (Class 2) shall be generated.

a. Digital contact alarms at each site.

b. Command – state mismatch for operation.

c. PLC minor fault.

d. Loss of PLC redundancy.

e. Building UPS alarm or low battery.

4. At a minimum, the following critical alarms (Class 1) shall be generated.

a. Loss of SCADA Workstation computer.

b. Loss of PLC and / or instrument power supply.

c. Loss of SCADA communications to any site.

d. Any PLC in non-run mode.

e. PLC major fault.

f. Loss of PLC redundancy > 24 hours.

g. UPS trip.

h. UPS battery failure.

i. Communication failure.

j. Software failure.

k. Synchronization module failure.

l. CPU failure.

m. Memory failure for any card.

n. Internal clock failure.

o. Security alarm on access by password and intrusion from outsider.

p. Date frame transmission failure.

q. CPU of PLC disconnected.

r. Parity error.

5. Alarms shall be sorted by time and class with most critical and recent alarms viewable on all SCADA workstation screens in the M/E Building. Alarms shall be displayed in the HMIs for all SCADA building alarms.

6. Alarms displayed at the SCADA Building HMIs shall be Class 3 and Class 2 alarms relevant to the location only. All Class 1 alarms shall be displayed at the all SCADA HMI and workstations.

7. Alarms shall be logged into an alarm database stored in each SCADA Server. Each alarm file shall be no longer than one week of recorded alarms before a new file is automatically generated.

8. The alarm messages shall be consistent in the way they are recorded. At a minimum, the alarm message shall display location name, user, Alarm Class, date / time stamp alarm for alarm state and alarm name.

9. Alarms shall provide a simple operator action describing the item and the location. E.g. for door switch alarm – "Check door switch in the SCADA Cabinet 200A"

10. Alarm names shall be meaningful and descriptive in regards to actual intent of the alarm.

11. Alarms shall have several defined states on the SCADA. Transition from one alarm state to another shall be logged in the alarm database and displayed in the alarm summary with visual indication to discern each state. Security shall be incorporated in alarm acknowledgment to allow only authorized users to acknowledge alarms. An audit trail of Alarm Acknowledgement shall be utilized and conform to 21 CFR Part 11 electronic signatures.

    a. Alarm Active State – in the alarm state and not acknowledged.

    b. Alarm Active and Acknowledged – in the alarm state and an operator has acknowledged the alarm.

    c. Alarm Active, Not Acknowledged and Cleared – the active alarm condition was not acknowledged but cleared on its own due to the change in condition.

    d. Alarm Active, Acknowledged and Cleared – the active alarm condition was acknowledged and cleared.

12. 'Acknowledge All' functions shall not be used as a possible method of acknowledging alarms.

13. An alarm Summary Display Screen shall be on each SCADA Workstation and each HMI. The screen shall have the ability to review prior alarms up to 3 months old.

14. The operator shall be notified through audible and visual indication that an alarm has been generated.

15. All alarms shall be generated in the PLC. For example, a command for a pump start results in the pump run proof not being received by the PLC. The PLC shall set a bit which will be read by the SCADA workstation and SCADA building HMIs. All alarms shall have delay timers with time settings documented when system cutover occurs.

16. Alarm Functionality shall be tested in detail during the sop testing and field testing.

H. SCADA Software Event Logging and Trending Functionality

1. The SCADA shall have the capability to log all system commands which will occur at the SCADA Workstations of SCADA Building HMI panels.

2. Events shall be logged into an event database stored in each SCADA Workstation. Each alarm file shall be no longer than one week of recorded alarms before a new file is automatically generated.

3. The event log files shall be used in the playback requirement and be viewed from any SCADA Workstation.

4. The event messages shall be consistent in the way they are recorded. At a minimum, the event message shall display location name, user, date / time stamp and description. Descriptions shall be meaningful in regards to actual intent of the alarm.

5. At a minimum, the following events shall be logged:

   a. SCADA Workstation or SCADA Building HMI Panel software shutdown or startup.

   b. User name and password entry for login and logout.

   c. Security timeout – system shall timeout users if no activity for 15 minutes (adj.).

   d. All SCADA commands (i.e. pump start button pushed, mode selected, pump start, etc.).

   e. Alarm acknowledgement.

6. All trending and data logging shall reside on the SCADA Servers. The SCADA Workstations shall have the capability to access the data.

7. All data logs shall have time/date stamps for each distinct point of data.

8. All digital status changes (i.e., pump run proof) shall be data logged on change of state at both the SCADA workstations and HMIs.

9. All analog values shall be data logged and trended on the SCADA Workstations. The data will be logged on deviation from last stored value rather than timed interval.

10. There will be no trending at the SCADA Building HMI panels.

I. SCADA Software Reporting Functionality

1. At a minimum the SCADA shall have capability to produce reports. Reports shall be formatted in a clear, logical format. The Contractor shall submit sample report formats to for review and approval.

2. The operator shall have the option to automatically generate any of the following preprogrammed reports on a daily, weekly, monthly and/or annual basis:

   a. Report of trips, alarms and failures.

b. Log of events and commands.

3. The operator shall have the ability to generate a report at any time utilizing filters and sorting tools to refine the report based on the following at a minimum:

   a. Time – From one date to another date hour to hour

   b. Location

   c. Devices and/or device types

   d. Data types - e.g. Alarms, trips, start commands, stop commands, failures.

4. The operator shall have the ability to export all data logged in the SCADA to a standard spreadsheet or database file form such as Microsoft Excel or Microsoft Access.

5. The report generation software shall be fully compatible with the SCADA Database management system, have graphical Operator Interface (with pull-down menus to limit Operator typing) and shall access data from and store Operator-entered and SCADA-generated data to the SCADA Database.

J. SCADA Software Security Functionality

1. The system shall have the capability to allow the system administrator to create, delete and modify user login and passwords for verification and authentication of system users.

2. The SCADA system shall not have any wireless or WiFi communications as part of the system architecture or for vendor servicing.

3. All SCADA operating systems shall have unused default network services disabled. The Contractor shall be responsible for SCADA Workstation configuration and ensuring that unused services are disabled.

4. All SCADA software shall be compatible with operating system security updates and patches.

5. The Contractor will be responsible for coordinating the SCADA security with the PA for integration on their network. At a minimum, the SCADA shall have the same level of security access as the other computerized systems in operations.

6. Password security guidelines and Username and Passwords that are incorporated into local Standard Operating Procedures (SOPs).

7. The Contractor shall ensure ports, protocols, and services (PPS) that are not required are denied at the network level and disabled at the system level.

8. The Contractor shall ensure, before establishing a user session, the system displays an advisory warning message regarding unauthorized use of the system.

9. The Contractor shall ensure safeguards are put in place to ensure that each person having access to systems possess the "need to know" and have requisite security clearance.

10. Supply a means for audit trails to be reviewed for security implications at least once per week.

11. Role-based access control mechanism to enforce a "least privilege" security policy, i.e., users should not be granted a role with more privileges than required by their job description.

2.03 CONSTRUCTION FEATURES

A. RCU/RIO Cabinets

1. Cabinets

a. Acceptable manufacturers are Hoffman, Rittal, or approved equal.

b. Components and/or auxiliary instruments mounted at the rear of a panel shall be mounted so that they are readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument. In addition, each instrument or component shall be identified with a permanently affixed tag bearing the item tag number.

c. All interior mounted auxiliary equipment and wiring terminal strips shall be mounted on sub-panels, which shall be shown on the Contractor's drawings.

d. AC and DC circuits shall not be run in the same wireway or raceway. DC circuits shall be Blue. AC power circuits shall be black, and switched AC circuits shall be red. Control voltages for all devices shall be 24 VDC or 110 VAC. 240 or 480 VAC shall not be run in any enclosure with PLC's, I/O or instrument devices.

e. Control Panels shall not be used as a raceway.

f. Minimum size for signal wiring shall be #18AWG. Minimum size for power wiring shall be #12AWG.

g. At least one (1) drawing pocket with a size 9 inches by 12 inches x 3/4 inches or larger shall be provided to store arrangement, schematic and loop drawings.

h. The panels shall be complete as to brackets, racks and other devices required for stable support of instruments, controls and other accessories.

i. The enclosure shall incorporate a separate instrument ground bus that will accommodate separate instrument ground connections from all system devices and components. The RCU instrument ground bus shall be designed to serve as the single-point bond between the instrument ground and the enclosure/distribution system ground.

j. Each I/O cabinet shall be provided with a lockable handle. All I/O rack configuration parameters will be in a file and stored in the change management program database.

2. Surge Suppression Devices

a. Each Control Cabinet shall be supplied with a surge protection device as part of the input power terminals, as indicated on the contract drawings.

b. The surge protection device shall be rail mounted with a protection for a minimum total surge current of 20kA.

c. The surge protection device shall be sized by the Contractor to ensure that the nominal device current is sufficient for the control power circuits.

3. Power Supplies

a. All control panels shall have a 20 amp duplex receptacle fed by a 20-amp breaker.

b. Each panel shall have dedicated power supplies for powering all control system equipment as required.

c. The power supply modules shall protect themselves and the devices they supply from voltage spikes with surge suppressors, voltage sensors and fuses.

d. All power supplies shall be located within the control panel.

e. Power supplies shall be designed for 30 percent spare capacity. The Contractor shall provide a listing of all items provided power by the supply with expected in-rush and carrying requirements.

4. Panel Circuit Breakers

a. All Cabinet power circuits shall be protected by means of circuit breakers

b. Electronic fusing shall be acceptable only if electronic fusing is an integral part of the specified I/O module, and a form of fault indication can be provided to the HMI display or SCADA Servers.

5. Cable Management and Mounting rails

a. Provide rigid, nonflammable restricted slot sidewall wiring duct with snap cover for all wiring in cabinet. All circuits in the control panels shall be run in wireways. No circuits shall be run over devices or wireway covers.

b. Provide wire retainers as required. Wiring duct shall be UL listed with a flammability classification of 94V-0. Wiring duct shall be as manufactured by Thomas & Betts "Ty-Duct Wiring System" or approved equal.

6. Grounding Strip

a. A copper grounding strip with pre drill connection holes shall be provided within each cabinet.

7. Door Switch

a. Cabinet door switch shall be provided that shall provide an alarm contact when door is open.

8. Control Relays

a. All control relays shall contain an LED indicator of contactor position status.

9. Indicator Lamps

a. All indicator lamps mounted to the panel shall be LED type.

10. Terminal Strips

a. Terminal blocks shall be double-row collar type screw terminals with spring action overlapping top plates rated for 30 amperes, 600 volts with barrier strips between each adjacent row of terminal positions. Terminal blocks shall conform to NEMA ICS-4 and UL 50. Each terminal shall have a white marking strip and plastic cover. Provide 25 percent spare terminals. Mount terminal blocks securely to bracket assembly with stainless steel screws and washers. Terminals shall be grouped and segregated for different operating voltages.

11. Labeling

a. Each instrument or component shall be identified with a permanently affixed tag bearing the item tag number.

12. Wire color coding

a. The Contractor shall comply with the NEC requirements for wire color coding.

b. For data cables the Contractor shall propose a logic wire color coding system for approval.

2.04 SHOP TESTING

A. The SCADA system controls equipment shall be approved for shipment only after results for tests conducted at the factory have been satisfactorily completed. The engineer and personnel shall witness the factory acceptance test.

B. Factory tests shall not proceed without the prior approval and delivery of testing protocol documentation.

C. The Operation and Maintenance manuals shall be used during the factory acceptance tests as guides to equipment operation and as a check that each manual is correct and complete.

D. Prior to conducting factory acceptance tests, the Contractor shall carry out internal commissioning tests to demonstrate the SCADA readiness for acceptance. Testing and remediation documentation shall be provided.

E. Contractor shall be responsible for any time and expense for any tests deemed unsuccessful.

F. The Contractor shall develop and provide a detailed shop tests protocol for review and approval prior to any shop tests execution. After the shop tests protocol is approved and internal commissioning tests completed:

1. Contractor shall notify engineer ten (10) days in advance of shop testing.

2. Contractor shall have total responsibility for successful completion of shop testing.

3. Contractor shall provide all test equipment, and personnel required to perform the shop testing. Software engineering and shop personnel who were involved with the design shall be available during shop tests execution.

4. Controls and Automation:

a. The supplied SCADA Workstations shall be used to operate equipment during the shop testing.

b. Functionality of all SCADA workstations and HMI functions shall be tested. Sample tests are not acceptable.

c. Contractor shall provide all test equipment not previously mentioned including network cable/connections, network switches and any other infrastructure components in order to successfully run an integrated control system for shop testing.

d. FAT protocols shall include panel inspections for conformance to specifications.

G. The shop tests protocol as a minimum shall consist of the following:

1. Component Verification – Verify components and installation against specifications, materials of construction for product contact parts, that all identification plates fitted, and those components are free of obvious defects. Verify that specified component model numbers match the actual model numbers.

2. Wiring Verification – Verify that 100% point-to-point continuity testing and wiring diagram verification has been executed for each panel.

3. Configuration of Programmable Devices – Verify that the configuration of all programmable devices matches the system specification, system drawings and manufacturer's manuals. The Contractor shall verify that password protection is provided in accordance with 's specifications.

4. Last state configuration shall be tested by placing the processor in a non-functional state (PROGRAM mode or FAULT mode) and observing that the outputs remain in last state. A communication test with remote I/O racks shall be performed and the outputs from these racks shall remain in last state.

5. Software Documentation/Source Code - Document version of software prior to shop testing. All software used to develop the system shall be turned over to , including all licenses or registrations.

6. Operational Testing - consists of simulating the running of equipment per the sequence of operations to confirm proper operation. As a minimum, this shall include the following:

   a. Alarms and Interlocks Testing – perform testing on all alarms and interlocks as per the functional requirements document.

      (1) Proper action is taken by the control system for all alarm conditions.

      (2) All alarm conditions are properly enunciated and logged.

      (3) System returns to the proper state after each alarm condition has been cleared.

      (4) All interlocks function properly.

   b. The Contractor shall not release any equipment for shipment until obtaining written approval from confirming that all inspections and Factory Acceptance Testing have been completed to the Engineer's satisfaction. In the event waives inspections and witnessing of Factory Acceptance Tests, the Contractor shall obtain written confirmation of this prior to releasing any equipment for shipment.

7. All elements of the SCADA shall be tested at the SHOP TESTING. Sample testing is not acceptable.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall test continuity of all cabling associated with the SCADA system, and correct cabling where the continuity test fails.

B. The Contractor shall ensure that all cabling associated with the SCADA system is installed in a manner that does not exceed minimum bend radius and maximum pull force for the cable during installation and for the installed conditions. Each data cable connector shall be installed following the manufacturer's instructions. The link loss in dB shall be measured and recorded for each cable and associated connectors. The results for margin and link losses shall be tabulated and included in the Operations and Maintenance Manual.

3.02 FIELD QUALITY CONTROL

A. The field tests shall consist of a full retest of all components of the shop tests with actual SCADA equipment being controlled / monitored.

B. Afield tests shall be conducted for every panel, component and device of the SCADA at all locations.

C. The SCADA shall produce report a report of all equipment function and operations during the site acceptance tests.

D. The Operation and Maintenance manuals shall be used during the site acceptance tests as guides to equipment operation and as a check that each manual is correct and complete.

E. Prior to conducting site acceptance tests, the Contractor shall carry out commissioning tests to demonstrate the installations readiness for acceptance.

F. Contractor shall be responsible for any time and expense for any tests deemed unsuccessful.

G. Contractor shall provide a detailed field tests Protocol for review and approval prior to any field tests execution.

H. The site acceptance test shall be performed jointly by the Contractor and at each location.

I. If deficiencies are found, the Contractor shall incur all costs associated with bringing the equipment into compliance with the specification, the drawings, the data sheets, the performance specifications, and all referenced codes, standards, and attachments. If changes are made, the Contractor shall resubmit documents as required.

J. Contractor is to verify that no short circuits exist, power is present and at the appropriate voltage for UPS and normal power. All equipment with control systems shall be subject to a power outage recovery test and simulated UPS operation.

K. The SAT, as a minimum, shall consist of the following:

1. Performance Tests:

   a. Complete performance testing of the system as per the field tests document.

   b. Test each component, then subsystem, then system to ensure interoperability and will execute the sequence of operations.

2. Contractor shall perform interim tests during transition to ensure existing and new components are functional. Contractor shall develop this methodology and submit for approval. If system reliability degrades during installation, all testing will stop and Contractor shall be responsible for verifying integrity of the SCADA system. Continuance of work will not be allowed until the remediation has been completed and retests performed.

3. Operational Testing and Alarm and Interlock testing as described in the shop tests for each subsystem. System integration testing shall be performed to ensure sub-system to sub-system communication interlocks function correctly.

3.03 TRAINING

A. The Contractor shall prepare a comprehensive training program for personnel that provide training for the engineering, design, installation, operation, troubleshooting, testing, repair, and maintenance of the SCADA.

B. Training shall be divided into Design, Operation, and Maintenance sections, of which each section shall be conducted during distinct, separate training classes, and shall not be combined.

C. Training shall be conducted at an training facility with classes not less than seven (7) hours per normal working day.

D. SCADA training shall be given to employees as follows:

1. Employees shall receive two weeks of Design training with one week of training scheduled at the beginning of the contract, and the second week scheduled following installation of the new SCADA System.

2. Employees shall receive Operation training, during a minimum of two separate one (1) day training classes.

3. Employees shall receive Maintenance training, during a minimum of two separate one (1) day training classes.

E. In preparation for the training program, the Contractor shall design the program to ensure the level of knowledge is adequate for the design, installation, operation, and maintenance of the SCADA. The program shall include both instruction and exercises, and shall incorporate as necessary, the use of training aids such as professionally pre-printed material, videotape, mock-ups, schematics, manuals, and presentation material to ensure a thorough understanding of the subject material.

F. Design training shall include the development of the functionality for each display element. The training shall be applicable to the SCADA stated herein so that the designer can attain a comfort level with working with the system when it has been installed and placed in service.

G. Operation training shall include the proper operation and corresponding indication states for each type of display element, as well as the operation of all ancillary functions such as logging in/off and modifying control territory. The training shall be applicable to the SCADA stated herein such that each user shall be capable of controlling the territory specified herein. Hands-on operation training shall include the opportunity for all students to experience both normal routine operations scenarios, in addition to exception case "emergency" situations.

H. Maintenance training shall include all required hardware and software maintenance tasks required by the SCADA. This includes but is not limited to the installation, testing, troubleshooting, repair, of the control system and Ethernet network as well as viewing, saving, or printing event logged reports, files purging, SCADA simulation and playback procedures.

I. The Contractor's instructors shall have a thorough knowledge of, and experience with engineering, design, testing, and development of the system and equipment under discussion. The Contractor shall submit the resume of all instructors for approval by the Engineer, 60 days prior to the start of training.

J. The Contractor shall prepare and submit for approval, the SCADA Training Manual. This manual shall be a detailed description of the training programs in order to train the employees to instruct in the future (train-the-trainer).

1. The SCADA Training Manual shall also include the Contractor's course outlines and lesson plans for all training, including Design, Operation, and Maintenance training. The Contractor shall submit the course outlines and lesson plans, including the number of sessions that will be required for Design training, Operation training and for Maintenance training, to the Engineer for review and approval as part of the Training Manual, 105 days after Notice to Proceed.

2. The SCADA Training Manual shall be submitted for approval as specified elsewhere in this Section. Upon final approval, the Contractor shall supply 10 bound hardcopies of each SCADA Training Manual, as well as the electronic file on CD in an approved format.

K. The Engineer shall retain the right to attend any and all training sessions.

L. The Contractor shall make video recordings of all training sessions, to be used by instructors as a reference library.

M. This training is in no way to be considered as superseding the conventional functions of the Contractor and/or subContractor's field service engineers.

N. There shall be, at a minimum, four (4) hours of SCADA security training. This is an administration level of training and shall encompass the following:

1. SCADA security design.
2. Security administration procedures.
3. Physical SCADA security.
4. SCADA Workstation security.
5. PLC and communications security.

END OF SECTION

SECTION 16936

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM (FOR BAYONNE BRIDGE SYSTEMS)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Bill of Materials as per the approved catalog cuts
2. Terminal block connection diagrams for all system components.
3. Detailed schematic drawings of all components, circuitry and interfaces to equipment and Systems.

B. Catalog Cuts

1. Provide Catalog Cuts of all components to be installed within RCU and RIO cabinets, including cabinets and mountings.
2. Provide Catalog Cuts of cables and cable terminations.

C. Samples

1. Submit for approval - sample screens for the SCADA System.

D. Product Data

(Not Applicable)

E. Certificates

(Not Applicable)

F. Manufacturer Test Reports

1. Provide a factory acceptance test document to test all software functionality including the HMI screens. Test shall be approved prior to execution.
2. Provide a site acceptance test document to test all components supplied with the SCADA. Test shall be approved prior to execution.
3. Provide and document system integration testing, and submit test reports.

G. Construction and Installation Procedures

1. Submit for approval – SCADA System Wire Color Coding Scheme.

H. Calculations

1. Provide reliability and availability calculations for the SCADA system.

I. Manuals, Warranties/Guarantees

1. At a minimum the Contractor shall submit the following documents in relation to the SCADA system operations for review and approval, as detailed below:

   a. SCADA Operations and Maintenance Manual

   b. SCADA Instruction Manual

   c. Emergency SCADA Operations Manual

2. SCADA HMI screens, alarm schedules and sample reports shall be provided at each stage of project development for review and approval.

3. Each manual shall have the following identification inscribed on the cover and each page of the document: the document name, e.g. "OPERATIONS AND MAINTENANCE MANUAL", the name and location of the project, e.g. "BAYONNE BRIDGE", date, version, e.g. "FINAL DOCUMENT", page number, the name of the Contractor, and the Contract number.

4. Each manual shall be submitted by the Contractor in both Microsoft word and PDF format (in addition to hard copies described below).

5. Contractor is responsible for providing a detailed SCADA security management section as part of the overall O&M manual. This shall detail the security of the SCADA system and how passwords and usernames are to be managed.

6. The SCADA Operations and Maintenance Manual shall be provided to a level that will allow a trained maintenance Contractor or engineer to perform maintenance and upgrades to the SCADA. At a minimum the SCADA O&M shall include the following:

   a. Software Design Description (SDD)

      (1) The SDD shall conform to IEEE Standard 1016, with specific attention to the following components.

      (2) Architecture of the software, identifying and describing the functions, logic and design of each software module as well as data formats and flow between modules.

      (3) Database and data structures with file and folder locations.

      (4) Performance requirements of the software (e.g., availability, response times, capacity and throughput, integrity of operation, and maintainability)

      (5) Software development environment and tools.

      (6) For each external interface, including but not limited to remote field devices, network communication protocols, and time synchronization, include states, protocols and message formats. Special attention shall be given to the particular interfaces to be managed concerning SCADA equipment.

      (7) Hard and electronic copies of the SCADA and PLC software, including application source code, data table allocations, and descriptions of main software modules.

      (8) File, data, variable and software module naming conventions.

      (9) Completed documentation on the protocol, message formats and I/O device and bit assignments between the SCADA and each non-vital processor or PLC supported by the SCADA.

(10) Software and HMI failover and restart.

(11) Software Backup/restore utility.

(12) Software Disaster Recovery Plan.

(13) Methods and facilities used to maintain, store, secure and document controlled versions of the identified software developed as well as externally acquired COTS products.

(14) *Software version description document, software and firmware listings, and* software and firmware source code (un-compiled with comments as well as compiled), for applications software and firmware provided under this Contract.

(15) All "make" or equivalent files for editing, compiling, linking, and installing application software; all files required to define, allocate and load the SCADA Database.

(16) The approval cycle of SCADA Software Upgrades.

b. Display Design Guidelines (DDG)

(1) The Display Design Guidelines shall provide guidelines relating to, and for use of display monitors, inter-display navigation, icons, colors, labels, display attributes, menu bars, task bars, dialogue boxes, and prompts and messages. The DDG shall document the SCADA user interface and shall include graphical representations of all controls and indications.

(2) The DDG shall include a table for each individual display that will chart display contents, colors, and formats, Operator commands, messages, indicators, and display behavior.

c. The Contractor shall submit to the Engineer for acceptance two copies of the preliminary Operations and Maintenance Manuals for each system at least 30 days before shipment of first relevant unit that shall provide technical support for SCADA equipment operation and maintenance. After acceptance of the preliminary submittal and having made all necessary corrections and amendments required, Contractor shall provide the Engineer with 10 additional copies of the accepted and dated Operations and Maintenance Manuals. The Manuals shall provide a clear explanation of the theory, operation, and maintenance of the equipment accompanied by photos and schematic, wiring and mechanical assembly diagrams, as required. The Manuals shall be indexed and cross-referenced in an easily understood manner.

d. At the conclusion of the project the Contractor shall resubmit 10 additional copies of the Operations and Maintenance manual marked "FINAL" with the date listed. The "FINAL" issue shall contain all necessary addendums resulting from installation, training and testing of the system during construction.

7. SCADA Instruction Manual

a. The SCADA instruction manual shall be provided to allow Operators to understand all user functions and operations of the SCADA in one document. The SCADA Instruction manual shall reference sections of the O&M manual for more detail information. At a minimum the SCADA Instruction manual shall contain the following sections:

(1) Chapter 1 – SCADA Description

(2) Chapter 2 – Components: Functions and Locations

(3) Chapter 3 – Operations

3.1 - Introduction

3.2 - Automatic Actions

3.3 - Manual Actions

3.4 - HMI Screens

3.5 - Basic Tasks

(4) Chapter 4 – Troubles and Corrections

(5) Chapter 5 – Glossary

(6) Chapter 6 – Maintenance and Checklists

8. Emergency SCADA Operations Manuals

a. The SCADA Emergency SCADA Operation Manuals shall be clear and concise documents containing step by step instructions to operate SCADA equipment in response to a fire or emergency condition on the Bridge.

b. The SCADA Emergency SCADA Operations Manuals shall contain HMI screen shots for each mode of emergency SCADA operations, with step by step instructions of the commands to be entered and the expected HMI confirmations.

c. The SCADA Emergency SCADA Operations Manuals shall contain tabbed pages to allow an operator to quickly open to the specific emergency mode required.

d. The SCADA Emergency SCADA Manuals shall also contain an appendix that shall detail Manual SCADA Operations in the event of partial or complete loss of operability of the SCADA Control system.

J. Schedules

1. SCADA HMI screens and alarm schedules.

2. Detailed description of all SCADA System Logic functions

3. Sample reports generated by the SCADA

K. Qualifications

1. Submit a list of a minimum of three installations, all of which shall be located in the United States, which shall have included work, comparable in type, size and complexity. Said installations shall be in satisfactory operation for the last three consecutive years, at minimum. Furnish references and current contact information for each project.

2. Furnish references and current contact information for each project.

3. Furnish the resumes of all key project management, integration and installation personnel.

4. Furnish certifications of training of key personnel in the integration, installation and maintenance of the data network equipment.

5. Approval of qualification information is required prior to transmittal of any further submittals of this Section.

L. Quality Assurance-Quality Control

1. Software Quality Assurance Plan (SQAP)

   a. The Contractor shall develop and document the approach for performing effective software quality assurance and for identifying individuals responsible for performing Software Quality Assurance activities such as control system upgrades and modifications in a Software Quality Assurance Plan (SQAP). The SQAP shall be developed in accordance IEEE Standard 730.

2. Contractor shall submit the Software Development Quality Control Procedures which shall include (but not limited to) the following:

   a. Configuration tools, methodologies

   b. Maintenance, backup procedures and associated records

   c. Software development tools (hardware and software). Contractor shall review these tools with prior to starting software development and where practiced, shall conform to 's in-house standards.

   d. Procedures for acceptance and sign-off of produced software including individual's names and titles responsible for sign-off activities.

3. The Contractor shall disclose all SCADA access points used during construction and disable all access points upon project completion. The use of backdoor access is not allowed. The Contractor shall demonstrate that all access has been removed upon project completion.

4. A comprehensive list of SCADA access points, including communications points, shall be delivered upon project completion. The list shall include all physical ports, configuration of the ports, along with software and physical access.

M. Record Documents

1. The Contractor shall submit an alarm management matrix for each alarm as part of his HMI submittal package. The matrix shall define all components of the alarm.

N. Spare Parts List

1. Manufacturer shall submit a recommended spare parts list.

O. Inspection Reports

(Not Applicable)

P. Contact Information

1. Furnish the Company name, single point of contact: name, address, email and telephone number of the SCADA System, Manufacturer, Integrator and Installer.

Q. Training

1. The Contractor shall make and submit video recordings of all training sessions, to be used by instructors as a reference library.

2. The Contractor shall prepare and submit for approval, the SCADA Training Manual. This manual shall be a detailed description of the training programs in order to train the employees to instruct in the future (train-the-trainer).

   a. The SCADA Training Manual shall also include the Contractor's course outlines and lesson plans for all training, including Design, Operation, and Maintenance training. The Contractor shall submit the course outlines and lesson plans, including the number of sessions that will be required for Design training, Operation training and for Maintenance training, to the Engineer for review and approval as part of the Training Manual, 105 days after Notice to Proceed.

   b. The SCADA Training Manual shall be submitted for approval as specified elsewhere in this Section. Upon final approval, the Contractor shall supply 10 bound hardcopies of each SCADA Training Manual, as well as the electronic file on CD in an approved format.

R. Closeout Submittals

1. Provide a copy, on disk, of ALL PLC and Workstation and HMI programs after the successful commissioning and acceptance of the new SCADA. Including an electronic copy of the comprehensive system I/O address map.

S. Information

(Not Applicable)

T. Permits

(Not Applicable)

U. Maintenance Agreements

1. Contractor shall submit a maintenance agreement for approval by the Authority.

V. Sustainability Submittals

(Not Applicable)

END OF APPENDIX "A"

SECTION 16936

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM (FOR BAYONNE BRIDGE SYSTEMS)

APPENDIX "B"

SAMPLE SCADA SOFTWARE SCREENS

The following sample screens are provided as an indication of the detail and functionality that is required by the Contractor. The quantity of sample screens provided is not representative of the quantity of screens required under the contract:

A. SAMPLE SCREEN - Bayonne Bridge System Status

B. SAMPLE SCREEN - Bayonne Bridge Location Status

C. SAMPLE SCREEN - Bayonne Bridge Power Distribution System

D. SAMPLE SCREEN - Bayonne Bridge UPS& Batteries

E. SAMPLE SCREEN - Bayonne Bridge Roadway Lighting

F. SAMPLE SCREEN - Bayonne Bridge Generators

G. SAMPLE SCREEN - Bayonne Bridge Building Management System

H. SAMPLE SCREEN - Bayonne Bridge Fire Alarm

I. SAMPLE SCREEN - Bayonne Bridge Aesthetic Lighting

J. SAMPLE SCREEN - Bayonne Bridge Standpipe

K. SAMPLE SCREEN - Bayonne Bridge Admin Building/Hazardous Materials Store

L. SAMPLE SCREEN - Bayonne Bridge SCADA System Status

M. SAMPLE SCREEN - Bayonne Bridge Alarm Log

[redacted]

END OF APPENDIX "B"

General Decision Number: NY130003 02/08/2013 NY3

Superseded General Decision Number: NY20120003

State: New York

Construction Types: Building, Heavy, Highway and Residential

Counties: Bronx, Kings, New York, Queens and Richmond Counties in New York.

BUILDING & RESIDENTIAL CONSTRUCTION PROJECTS (includes single family homes and apartments up to and including 4 stories), HEAVY AND HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/04/2013
1	01/11/2013
2	01/18/2013
3	02/08/2013

ASBE0012-001 01/02/2012

	Rates	Fringes
Asbestos Workers/Insulator Includes application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems	$ 61.08	26.59
HAZARDOUS MATERIAL HANDLER	$ 30.00	9.10

BOIL0005-001 01/01/2012

	Rates	Fringes
BOILERMAKER	$ 47.98	32%+21.75+a

FOOTNOTE:

a. PAID HOLIDAYS: New Year's Day, Thanksgiving Day, Memorial Day, Independence Day, Labor Day and Good Friday, Friday after Thanksgiving, Christmas Eve Day and New Year's Eve

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BRNY0001-001 07/01/2012

	Rates	Fringes
BRICKLAYER	$ 49.09	22.93
MASON - STONE	$ 25.65	15.43

BRNY0001-002 07/01/2012

	Rates	Fringes
Pointer, cleaner and caulker.....	$ 42.69	21.74

BRNY0004-001 07/01/2012

	Rates	Fringes
MARBLE MASON.....	$ 54.19	28.3

BRNY0007-001 01/01/2011

	Rates	Fringes
TERRAZZO FINISHER.....	$ 42.86	28.55
TERRAZZO WORKER/SETTER.....	$ 44.39	28.55

BRNY0020-001 07/01/2012

	Rates	Fringes
MARBLE FINISHER.....	$ 43.60	27.10

BRNY0024-001 07/01/2012

	Rates	Fringes
BRICKLAYER		
MARBLE POLISHERS.....	$ 38.03	20.90

BRNY0052-001 06/04/2012

	Rates	Fringes
Tile Layer.....	$ 50.25	27.66

BRNY0088-001 06/04/2012

	Rates	Fringes
TILE FINISHER.....	$ 39.67	24.16

CARP0001-009 07/01/2008

	Rates	Fringes
Carpenters:		
Carpenters & Soft floor layers.....	$ 43.02	35.96

CARP0740-001 07/01/2010

	Rates	Fringes
MILLWRIGHT.....	$ 46.19	44.93

CARP1456-004 01/01/2011

	Rates	Fringes
Dock Builder & Piledrivermen		
DOCKBUILDERS	$ 46.21	38.36

CARP1456-005 01/01/2011

	Rates	Fringes
Diver Tender	$ 41.16	38.46
Diver	$ 58.01	38.46

CARP1536-001 10/01/2010

	Rates	Fringes
Carpenters:		
TIMBERMEN	$ 42.63	31.32

ELEC0003-001 11/09/2011

	Rates	Fringes
ELECTRICIAN		
Electricians	$ 51.00	23.672
Jobbing, and maintenance and repair work	$ 25.30	15.13+a

PAID HOLIDAYS:

a. New Years Day, Martin Luther King, Jr.'s Birthday, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Election Day, Thanksgiving Day, the day after Thanksgiving Day, and Christmas Day

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ELEC1049-001 04/01/2012

QUEENS COUNTY

	Rates	Fringes
Line Construction (Substation and Switching structures pipe type cable installation and maintenance jobs or projects; Railroad electrical distribution/transmission systems maintenance (when work is not performed by railroad employees) Overhead and Underground transmission/distribution line work. Fiber optic, telephone cable and equipment)		
Groundman	$ 28.28	28.5%+9.75

Heavy Equipment Operator....	$ 37.70	28.5%+9.75
Lineman and Cable Splicer...	$ 47.13	28.5%+9.75
Tree Trimmer.....	$ 23.06	28.5%+9.75

ELEV0001-002 03/17/2012

	Rates	Fringes
ELEVATOR MECHANIC		
Elevator Constructor.....	$ 55.20	26.105+a+b
Modernization and Repair....	$ 43.79	25.955+a+b

FOOTNOTE:

a. PAID HOLIDAYS: New Year's Day, Good Friday, President's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

b. PAID VACATION: An employee who has worked less than 5 years shall recieve vacation pay credit on the basis of 4% of his hourly rate for all hours worked; an employee who has worked 5 to 15 years shall receive vacation pay credit on the basis of 6% of his hourly rate for all hours worked; an employee who has worked 15 or more years shall receive vacation pay credit on the basis of 8% of his hourly rate for all hours worked.

ENGI0014-001 07/01/2012

	Rates	Fringes
Pavement equipment operator		
Asphalt Plants.....	$ 51.32	25.88+a
Asphalt roller.....	$ 60.85	25.88+a
Asphalt spreader.....	$ 62.51	25.88+a
Power Equipment Operator (HEAVY & HIGHWAY)		
GROUP 1.....	$ 81.09	25.88
GROUP 10.....	$ 58.43	25.88
GROUP 11.....	$ 54.50	25.88
GROUP 12.....	$ 55.73	25.88
GROUP 13.....	$ 56.19	25.88
GROUP 14.....	$ 42.11	25.88
GROUP 15.....	$ 39.03	25.88
GROUP 2.....	$ 66.70	25.88
GROUP 3.....	$ 68.86	25.88
GROUP 4.....	$ 67.21	25.88
GROUP 5.....	$ 65.86	25.88
GROUP 6.....	$ 63.18	25.88
GROUP 7.....	$ 64.38	25.88
GROUP 8.....	$ 62.51	25.88
GROUP 9.....	$ 61.14	25.88
Steel erector		
Compressors, Welding Machines.....	$ 39.86	24.15
Cranes, Hydraulic Cranes,		

2 drum derricks,		
Forklifts, Boom Trucks.....	$ 67.71	24.15
Three drum derricks.....	$ 70.50	24.15
Utility Laborer		
Horizontal Boring Rig.....	$ 56.24	24.15
Off shift compressors.....	$ 46.38	24.15
Utility Compressors.....	$ 36.37	24.15

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Tower crane

GROUP 2: Backhoes, power shovel, Hydraulic clam shells, moles and machines of a similar type

GROUP 3: Mine hoists and crane, etc. used as mine hoists

GROUP 4: Gradalls, keystones, cranes (with digging buckets), bridge cranes, trenching machines, vermeer cutter and machines of a similar nature

GROUP 5: Piledrivers, derrick boats, tunnel shovels

GROUP 6: All drills, and machines of a similar nature

GROUP 7: Back filling machines, cranes, mucking machines, dual drum pavers

GROUP 8: Mixers (concrete w/loading attachments), concrete pavers, cableways, land derricks, power house (low pressure units), concrete pumps

GROUP 9: Concrete plants, well drilling machines, stone crushers double drum hoist, power house (other than above)

GROUP 10: Concrete mixers

GROUP 11: Elevators

GROUP 12: Concrete breaking machine, Hoists (single drum), load masters, locomotive and dinkies over 10 tons

GROUP 13: Vibratory console

GROUP 14: Compressors (portable 3 or more in battery), tugger machine (caissons), well point pumps, chum drill

GROUP 15: Boilers, (high pressure, compressors (portable, single, or 2 in battery, not over 100' apart), pumps (river cofferdam and welding machines (except where arc is operated by members of local 15) push button machines, all engines irrespective of power (power pac) used to drive auxilliary equipment, air, hydraulic etc.

PREMIUMS ON CRANES (Crawler or Truck):
100' to 149' boom - add .50
150' to 249' boom - add .75

250' to 349' boom - add 1.00
350' to 450' boom - add 1.50

Premiums for Cranes on Steel Erection:
100' to 149' boom - add 1.75
150' to 249' boom - add 2.00
250' to 349' boom - add 2.25
350' to 450' boom - add 2.75
Tower crane - add 2.00

FOOTNOTE:
a. Paid Holidays: New Year's Day; Lincoln's Birthday; Washington's Birthday; Memorial Day; Independence Day; Labor Day; Veterans Day; Columbus Day; Election Day; Thanksgiving Day; and Christmas Day; provided the employee works one day the payroll week in which the holiday occurs.

ENGI0014-002 07/01/2012

	Rates	Fringes
Power Equipment Operator		
BUILDING & RESIDENTIAL		
GROUP 1	$ 58.57	24.15
GROUP 2	$ 62.15	24.15
GROUP 3	$ 61.06	24.15
GROUP 4	$ 55.46	24.15
GROUP 5	$ 41.32	24.15

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Double drum

GROUP 2: Stone derrick, cranes, hydraulic cranes, boom trucks

GROUP 3: 4 pole Hoist, Single Drum Hoists

GROUP 4: Fork lift, house cars, plaster (platform machine), plaster bucket, concrete pump and all other equipment used for hoisting material

GROUP 5: Compressors, welding machines (cutting concrete work), paint spraying, sand blasting, pumps (with the exclusion of concrete pumps), house car (settlement basis only), all engines irrespective of power (power pac) used to drive auxiliary equipment, air, hydraulic, etc., boilers

Premiums for Cranes:
100'-149' boom - add 1.75
150'-249' boom - add 2.00
250'-349' boom - add 2.25
350'-450' boom - add 2.75
Tower cranes add 2.00

FOOTNOTE:
a. PAID HOLIDAYS: New Year's Day, Lincoln's Birthday,

Memorial Day, Independence Day, Labor Day, Veteran's Day, Columbus Day, Election Day, Thanksgiving Day, and Christmas Day, provided the employee works one day in the payroll week in which the holiday occurs

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* IRON0040-002 01/01/2013

BRONX, NEW YORK, RICHMOND

	Rates	Fringes
IRONWORKER, STRUCTURAL	$ 46.00	50.23

IRON0046-003 07/01/2011

	Rates	Fringes
IRONWORKER METALLIC LATHERS AND REINFORCING IRONWORKERS	$ 40.00	24.97

IRON0197-001 07/01/2012

	Rates	Fringes
IRONWORKER STONE DERRICKMAN	$ 40.50	35.93

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* IRON0361-002 01/01/2013

KINGS, QUEENS

	Rates	Fringes
Ironworkers: (STRUCTURAL)	$ 46.00	50.23

IRON0580-001 07/01/2012

	Rates	Fringes
IRONWORKER, ORNAMENTAL	$ 41.50	40.62

LABO0006-001 07/01/2011

	Rates	Fringes
Laborers: BUILDING CONSTRUCTION CEMENT AND CONCRETE WORKERS	$ 38.98	26.08

LABO0029-001 07/01/2012

	Rates	Fringes
Laborers:		

Heavy
Blasters (hydraulic trac drill).....$ 41.30 29.25
Blasters.....$ 40.55 29.25
Hydraulic Trac Drill.....$ 29.92 29.25
Jackhammers, Chippers, Spaders, Concrete Breakers, All Other Pneumatic Tools, Walk Behind Self-Propelled Hydraulic Asphalt and Concrete Breaker.....$ 34.64 29.25
Powder Carriers.....$ 31.08 29.25
Wagon; Airtrac; Quarry Bar Drill Runners.....$ 35.07 28.00

LABO0078-001 12/01/2011

	Rates	Fringes
LABORERS		
BUILDING CONSTRUCTION		
ASBESTOS (Removal, Abatement, Encapsulation or Decontamination of asbestos); LEAD; & HAZARDOUS WASTE LABORERS (Hazardous Waste, Hazardous Materials, Biochemical and Mold Remediation, HVAC, Duct Cleaning, Re-spray Fireproofing, etc).....	$ 35.10	14.85

LABO0079-001 01/01/2013

	Rates	Fringes
Laborers Building Construction		
Demolition Laborers		
Tier A.....	$ 35.21	22.59
Tier B.....	$ 24.75	16.65
Mason Tenders.....	$ 34.50	23.05

CLASSIFICATIONS

TIER A: Responsible for the removal of all interior petitions and structural petitions that can consist of sheet rock, block or masonry. Also, all structural slab openings for ducts, mechanical, shafts, elevators, slab openings and exterior walls where the building is not being completely demolitioned.

TIER B: Responsible for shoveling of debris into containers, pushing containers from the inside to the outside of the building.

LABO0147-001 07/01/2012

	Rates	Fringes
LABORERS (FREE AIR & TUNNEL).....	$ 58.30	27.20

Maintenance Men, Inside Muck Lock Tenders, Pump Men, Electricians, Cement Finishers, Caulkers, Hydraulic Men, Shield Men, Monorail Operators, Motor Men, Conveyor Men, Powder Carriers, Pan Men, Riggers, Chuck Tenders, Track Men Painters, Nippers, Brakemen, Cable Men, Hose Men, Grout Men, Gravel Men, Form Workers, Concrete Workers, Tunnel Laborers, Mole Nipper (one (1) Mole Sipper per Working Shaft per Shift for up to and including Two (2) Moles

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LABO0731-001 07/01/2011

	Rates	Fringes
Laborers:		
Building, Heavy and Residential Construction		
UNSKILLED.....	$ 38.20	30.27
UTILITY LABORER.....	$ 38.05	30.27
Heavy & Highway Construction		
LABORER/EXCAVATION (Asbestos, Lead, Hazardous Waste Removal (including soil).....	$ 36.64	26.21

Paid Holidays: Labor Day and Thanksgiving Day

LABO1010-001 07/01/2011

	Rates	Fringes
Laborers:		
HIGHWAY CONSTRUCTION		
Fence Installer & Repairer.	$ 38.34	30.25
FORMSETTERS.....	$ 42.21	30.25
LABORERS.....	$ 38.34	30.25
Landscape Planting & Maintenance.....	$ 38.34	30.25
Maintenance Safety Surface.	$ 38.34	30.25
Slurry/Sealcoater/Play Equipment Installer.....	$ 38.34	30.25
Small Equipment Operator (Not Operating Engineer).....	$ 28.94	15.55+a
Small Equipment Operator (Not Operating Engineer)...	$ 38.34	30.25
Small Power Tools Operator.	$ 38.34	30.25

FOOTNOTES:

a. PAID HOLIDAYS: Memorial Day, Fourth of July, Labor Day,

Columbus Day, Election Day and Thanksgiving Day, provided the employee has worked one (1) day in the calendar week in which the said holiday occurs.

LABO1010-002 07/01/2011

	Rates	Fringes
Laborers-Asphalt Construction:		
Micro Paver	$ 44.86	30.25
Raker	$ 44.37	30.25
Screedperson	$ 44.86	30.25
Shoveler (Production Paving Only)	$ 41.08	30.25
Small Equipment Operator (Asphalt)	$ 41.08	30.25

PAIN0009-001 11/01/2012

	Rates	Fringes
GLAZIER	$ 40.00	32.89
Painters:		
Painters, Drywall Finishers, Lead Abatement Worker	$ 36.00	20.87
Spray, Scaffold and Sandblasting	$ 39.00	20.87

PAIN0806-001 10/01/2012

	Rates	Fringes
Painters:		
Structural Steel and Bridge	$ 47.00	32.08

PAIN1974-001 12/26/2012

	Rates	Fringes
Painters:		
Drywall Tapers/Pointers	$ 43.82	22.01

PLAS0262-001 02/01/2012

	Rates	Fringes
PLASTERER	$ 40.78	26.80

PLAS0262-002 02/01/2012

KINGS AND QUEENS COUNTIES

	Rates	Fringes
PLASTERER	$ 40.78	26.80

PLAS0780-001 07/01/2012

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 44.63	38.95

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* PLUM0001-001 01/01/2013

	Rates	Fringes
PLUMBER		
MECHANICAL EQUIPMENT AND SERVICE		
Any repair and/or replacement of the present plumbing system that does not change the existing roughing	$ 33.21	16.05
PLUMBERS:	$ 52.86	36.21

PLUM0638-001 06/27/2012

	Rates	Fringes
PLUMBER		
SERVICE FITTERS	$ 26.30	2.55
SPRINKLER FITTERS, STEAMFITTERS	$ 51.25	49.54

Service Fitter work shall consist of all repair, service and maintenance work on domestic, commercial and industrial refrigeration, air conditioning and air cooling, stoker and oil burner apparatus and heating apparatus etc., including but not exclusively the charging, evacuation, leak testing and assembling for all machines for domestic, commercial and industrial refrigeration, air conditioning and heating apparatus. Also, work shall include adjusting, including capacity adjustments, checking and repairing or replacement of all controls and start up of all machines and repairing all defects that may develop on any system for domestic, commercial and industrial refrigeration and all air conditioning, air cooling, stoker and oil burner apparatus and heating apparatus regardless of size or type.

ROOF0008-003 07/01/2012

	Rates	Fringes
ROOFER	$ 39.00	27.35

SHEE0028-002 09/15/2011

	Rates	Fringes
SHEET METAL WORKER		
BUILDING CONSTRUCTION	$ 48.90	36.00
RESIDENTIAL CONSTRUCTION	$ 27.22	16.48

TEAM0282-001 07/01/2012

	Rates	Fringes
Truck drivers:		
TRUCK DRIVERS:		
Asphalt.....	$ 37.47	38.5525+a
Euclids & Turnapulls.....	$ 37.57	38.5525+a
High Rise.....	$ 42.00	36.9125+a

FOOTNOTES:

PAID HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Election Day, Veterans' Day (Armistice Day), Thanksgiving Day, Day after Thanksgiving and Christmas Day. Employees working two (2) days in the calendar week in which a holiday falls are to be paid for such holiday, provided that they shape each remaining workday during such calendar week.

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the

effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division

U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: NJ130033 01/04/2013 NJ33

Superseded General Decision Number: NJ20120033

State: New Jersey

Construction Type: Building

County: Hudson County in New Jersey.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Modification Number	Publication Date
0	01/04/2013

ASBE0032-008 09/19/2011

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR (Includes the application of all insulating materials, protective coverings, coatings and finishings to all types of mechanical systems; also, the application of firestopping material to openings and penetrations in walls, floors, ceilings and curtain walls; also, all lead abatement)	$ 43.70	30.39

BRNJ0002-014 05/01/2012

	Rates	Fringes
BRICKLAYER (Including Caulking, Cleaning and Pointing)	$ 36.95	25.37

Work on high stacks: 22% per hour additional.

BRNJ0002-016 05/01/2011

	Rates	Fringes
MASON - STONE	$ 36.70	24.97

Work on high stacks: 22% per hour additional.

BRNJ0007-003 01/01/2012

	Rates	Fringes

Marble setter.....$ 53.20 26.33

BRNJ0007-022 12/05/2011

	Rates	Fringes
Tile finisher.....	$ 39.28	23.91
Tile setter.....	$ 49.64	26.91

Tile finisher:
Work grouting all epoxy: $10.00 additional per day.

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* CARP0006-009 11/01/2012

	Rates	Fringes
CARPENTER (Scaffold Builder).....	$ 41.49	56%

The first sixty feet at the regular rate, 10% per hour additional for each additional fifty feet thereafter.

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* CARP0006-010 11/01/2012

	Rates	Fringes
CARPENTER Including Acoustical Ceiling Installation, Drywall Hanging, Formwork, Batt and Blown Insulation...	$ 41.49	56%

CARP0029-008 05/01/2009

	Rates	Fringes
Soft floor layer.....	$ 39.45	49.75%

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* CARP0715-007 11/01/2012

	Rates	Fringes
Millwright.....	$ 42.28	56%

Work of erection and dismantling of elevators and towers, such as concrete conveyors and temporary material elevators, scaffolding or other structures to be used as scaffolding inside or outside of buildings: the first sixty feet at the regular rate, 10% per hour additional for each additional fifty feet thereafter.

ELEC0164-006 06/04/2012

	Rates	Fringes
ELECTRICIAN (Apartments over 4 units.).....	$ 47.69	62%
ELECTRICIAN (Including Low		

Voltage Wiring)

Cable splicer	$ 47.69	62%
Electrician	$ 47.69	62%

Work on line voltage of 440 or 480 volts: 10% per hour additional.

Work from trusses, scaffolds, frames, ladders and poles, 40 ft. or more above the ground or floor (does not include work from a manlift): 20% per hour additional.

Work on radio towers, transmission towers and smokestacks: 21% per hour additional.

ENGI0825-020 07/01/2012

	Rates	Fringes
Power equipment operators:		
GROUP 1	$ 42.02	27.25
GROUP 2	$ 40.43	27.25
GROUP 3	$ 38.52	27.25
GROUP 4	$ 36.89	27.25
GROUP 5	$ 35.18	27.25

Hazardous waste removal work:
Work on a state or federally designated hazardous waste site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: 20% per hour additional.

PAID HOLIDAYS:
New Year's Day, Washington's Birthday observed, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided 1) that the worker works three of the preceding five work days before the holiday; or, the work day before the holiday and the work day after the holiday; and, 2) that the worker works the work day before and the work day after the holiday.

DEFINITION OF GROUPS:

GROUP 1:
Backhoe, Including Backhoe Track; Boom; Concrete Paving Machine; Crane (all types, including overhead and straddle traveling type); Drill (down-the-hole drill, rotary drill, self-propelled hydraulic drill, self-powered drill); Elevating Grader; Excavator; Front End Loader (5 cu. yd. and over); Piledriver (length of boom, including length of leads, shall determine premium rate applicable); Trencher

GROUP 2:
Backhoe Loader Combo; Concrete Pumper; Grader/Blade (Finish);

Hoist; Hydraulic Crane, 10 Tons and under; Front End Loader (2 cu. yd. but less than 5 cu. yd.); Scraper; Side Boom

GROUP 3:
Asphalt Spreader; Bulldozer;Compressor(2 or 3) (in Battery) (within 100 ft.); Forklift; Front End Loader (1 cu. yd. and over but less than 2 cu. yd.); Lull; Mechanic; Paver, Asphalt; Roller, Blacktop; Tractor;

GROUP 4:
Bobcat/Skid Loader; Compressor (Single); Farm Tractor; Front End Loader (under 1 cu. yd.); Hydroseeder; Roller, Grade; Pump, Hydraulic

GROUP 5:
Oiler

IRON0011-012 01/01/2012

	Rates	Fringes
Ironworkers:		
Reinforcing	$ 36.04	39.10
Structural, Ornamental	$ 38.84	39.10

LABO0222-006 05/01/2009

	Rates	Fringes
LABORER		
MASON TENDER:		
Brick/Cement/Concrete	$ 28.55	19.42

LABO0222-010 05/01/2009

	Rates	Fringes
Laborers:		
Asphalt Shoveler, Asphalt Spreader, Common or General Laborer, Landscape Laborer, Power Tool Operator and Screedman	$ 28.05	19.42

LABO1030-002 05/01/2009

	Rates	Fringes
Asbestos Removal Laborer	$ 28.05	16.22

The removal, abatement, enclosure and decontamination of personal protective equipment, chemical protective clothing and machinery relating to asbestos and/or toxic and hazardous waste or materials which shall include but not necessarily be limited to: the erection, moving, servicing and dismantling of all enclosures, scaffolding and

barricades; the operation of all tools and equipment normally used in the removal or abatement of asbestos and toxic or hazardous waste or materials; the labeling, bagging, cartoning, crating, or other packaging of materials for disposal; the clean-up of the worksite; and all other work incidental to the removal, abatement, encapsulation, enclosure, and decontamination of asbestos and toxic or hazardous waste or materials; and, in addition, all work tasks involved in the maintenance and operation of energy resource recovery plants (co-generation plants)

PAIN0711-018 05/01/2011

	Rates	Fringes
DRYWALL FINISHER/TAPER.....	$ 36.81	18.79

PAIN0711-019 05/01/2009

	Rates	Fringes
PAINTER (Brush & Roller).....	$ 27.72	14.28
PAINTER (Spray).....	$ 30.50	14.28

PAIN0711-021 11/01/2011

	Rates	Fringes
Glazier.....	$ 40.11	19.21

Work welding or using a cutting torch:
$1.00 per hour additional.

Work on a swing stage scaffold; on a pipe scaffold providing the working height of the platform is 30 ft. or above; and on motorized lifts provided that the height of the lift platform is above the second floor or above thirty feet: $1.00 per hour additional.

PLAS0029-002 05/01/2012

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	$ 40.30	22.05

PLAS0029-003 05/01/2012

	Rates	Fringes
PLASTERER.....	$ 40.30	22.05

PLUM0024-001 05/01/2011

	Rates	Fringes
PLUMBER (Excluding HVAC Pipe		

Installation).....$ 46.31 28.09

PLUM0274-001 05/01/2012

HUDSON COUNTY (City of Bayonne; Borough of East Newark; Towns of Guttenberg and Harrison; Cities of Hoboken and Jersey City; Town of Kearney; Township of North Bergen; Town of Secaucus; City of Union City; Township of Weehawken; Town of West New York)

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation).....	$ 47.61	27.69

ROOF0004-007 06/01/2009

	Rates	Fringes
ROOFER (Includes All Types of Roofs).....	$ 32.82	18.77

ROOF0008-005 06/01/2010

HUDSON COUNTY (east of the Hackensack River):

	Rates	Fringes
ROOFER (All Types).....	$ 37.75	26.34

SFNJ0696-006 07/01/2011

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	$ 51.50	21.15

SHEE0025-005 06/01/2011

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation).....	$ 43.61	30.41

SUNJ2004-009 01/02/2009

	Rates	Fringes
ELEVATOR MECHANIC.....	$ 40.21	11.22
LABORER: Pipelayer.....	$ 38.85	0.14

TEAM0560-002 05/01/2011

	Rates	Fringes

TRUCK DRIVER

Dump Truck.....	$ 32.00	27.48
Off the Road Truck.....	$ 31.85	27.48

Hazardous waste removal work:

Work on a state or federally designated hazardous waste site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level A personal protection for any workers other than the truck driver: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level B, C or D personal protection for any workers other than the truck driver: $1.00 per hour additional.

PAID HOLIDAYS:

New Year's Day, President's Day, Decoration Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the employee has been assigned to work, or, "shapes", one day of the calendar week during which the holiday occurs.

DEFINITION OF GROUPS:

GROUP 1:

Driver of the following types of vehicle: dump; flat; float; pick-up; container hauler; fuel; water sprinkler; road oil; stringer bead; hot pass; bus; dumpcrete; transit mixer; agitator mixer; half track; winch truck; side-o-matic; dynamite; powder; x-ray; welding; skid; jeep; station wagon; stringer; A-frame; dual-purpose truck; truck with mechanical tailgate; asphalt distributor; batch truck; seeding; mulching; fertilizing; air compressor truck (in transit); parts chaser; escort; scissor; hi-lift; telescope; concrete breaker; gin pole; stone, sand, asphalt distributor and spreader; nipper; fuel truck (driver of fuel truck including handling of hose and nozzle - entire unit); team driver; vacuum or vac-all trucks (entire unit); skid truck (debris container - entire unit); concrete mobile truck (entire unit); beltcrete truck; pumpcrete truck; line truck; reel truck; wrecker; tow truck; utility truck; tack truck; cardex person; driver on the following types of vehicle: Broyhill coal tar epoxy truck, Littleford bituminous distributor, slurry seal truck or vehicle, thiokol track master pick-up (swamp cat pick-up); bucket loader dump truck and any rubber-tired tractor used in pulling and towing farm wagons and trailers of any

description; on-site repair shop

GROUP 2:
Driver of 3-axle materials truck and float

GROUP 3:
Driver of all Euclid-type vehicles: Euclid; International Harvester; Wabco; Caterpillar; Koehring, tractor and wagon; dumpster; dump; bottom, rear and side dump; carry-all and scraper (not self-loading, loading over the top); water sprinkler trailer; water pull and similar types of vehicle; driver of tractor and trailer-type vehicle: flat, float, I-beam, low bed, water sprinkler, bituminous, transit mix, road oil, fuel, bottom dump hopper, rear dump, office, shanty, epoxy, asphalt, agitator mixer, mulching, stringing, seeding, fertilizing, pole, spread bituminous distributor, water pull (entire unit), tractor trailer, reel trailer, and similar types of vehicle

GROUP 4:
Winch trailer driver

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination.

The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations

Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: NJ130054 01/04/2013 NJ54

Superseded General Decision Number: NJ20120054

State: New Jersey

Construction Type: Heavy

County: Hudson County in New Jersey.

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/04/2013

BRNJ0002-018 05/01/2012

	Rates	Fringes
BRICKLAYER	$ 36.95	25.37

Work on high stacks: 22% per hour additional.

BRNJ0004-001 05/01/2012

	Rates	Fringes
CEMENT MASON	$ 36.95	25.37

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* CARP0006-013 11/01/2012

	Rates	Fringes
CARPENTER (Including Form Work)	$ 41.49	56%

The first sixty feet at the regular rate, 10% per hour additional for each additional fifty feet thereafter.

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* CARP0715-007 11/01/2012

	Rates	Fringes
Millwright	$ 42.28	56%

Work of erection and dismantling of elevators and towers, such as concrete conveyors and temporary material elevators, scaffolding or other structures to be used as scaffolding inside or outside of buildings: the first sixty feet at the regular rate, 10% per hour additional for each additional fifty feet thereafter.

CARP1456-013 05/01/2008

	Rates	Fringes
CARPENTER (Dock Builder)		

Concrete form work.....	$ 37.00	27.02
All other work.....	$ 37.00	32.90

Work on land pile driving, floating marine construction and the construction of wharves, while handling and working with creosote and creosote-impregnated products: $.25 per hour additional.

Work on hazardous/toxic/contaminated waste removal, on a hazardous/toxic/contaminated waste site, where the worker comes into contact with hazardous/toxic/contaminated waste material, and when A, B or C personal protective equipment is required and used for respiratory, skin or eye protection: 20% per hour additional.

ELEC0164-008 06/04/2012

	Rates	Fringes
ELECTRICIAN		
Cable splicer.....	$ 47.69	62%
Electrician.....	$ 47.69	62%

Work on line voltage of 440 or 480 volts: 10% per hour additional.

Work from trusses, scaffolds, frames, ladders and poles, 40 ft. or more above the ground or floor (does not include work from a manlift): 20% per hour additional.

Work on radio towers, transmission towers and smokestacks: 21% per hour additional.

ENGI0825-021 07/01/2012

	Rates	Fringes
Power equipment operators:		
GROUP 1.....	$ 42.02	27.25
GROUP 2.....	$ 40.43	27.25
GROUP 3.....	$ 38.52	27.25
GROUP 4.....	$ 36.89	27.25
GROUP 5.....	$ 35.18	27.25

Hazardous waste removal work:
Work on a state or federally designated hazardous waste site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: 20% per hour additional.

PAID HOLIDAYS:
New Year's Day, Washington's Birthday observed, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided 1) that the worker works three of the preceding five work

days before the holiday; or, the work day before the holiday and the work day after the holiday; and, 2) that the worker works the work day before and the work day after the holiday.

DEFINITION OF GROUPS:

GROUP 1:
Backhoe, Including Backhoe Track; Boom; Concrete Paving Machine; Crane (all types, including overhead and straddle traveling type); Drill (down-the-hole drill, rotary drill, self-propelled hydraulic drill, self-powered drill); Elevating Grader; Excavator; Front End Loader (5 cu. yd. and over); Piledriver (length of boom, including length of leads, shall determine premium rate applicable)

GROUP 2:
Backhoe Loader Combo; Concrete Pumper; Grader/Blade (Finish); Hoist; Hydraulic Crane, 10 Tons and under; Front End Loader (2 cu. yd. but less than 5 cu. yd.); Scraper; Side Boom

GROUP 3:
Asphalt Spreader; Bulldozer; Compressor(2 or 3) (in Battery) (within 100 ft.); Crusher; Forklift; Front End Loader (1 cu. yd. and over but less than 2 cu. yd.); Lull; Mechanic; Paver, Asphalt; Roller, Blacktop; Tractor;

GROUP 4:
Broom; Compressor (Single); Farm Tractor; Front End Loader (under 1 cu. yd.); Roller, Grade; Pump

GROUP 5:
Oiler

IRON0011-012 01/01/2012

	Rates	Fringes
Ironworkers:		
Reinforcing	$ 36.04	39.10
Structural, Ornamental	$ 38.84	39.10

LABO0172-008 03/01/2011

	Rates	Fringes
Laborers:		
Landsacpe Laborer, Power Tool Operator	$ 32.20	21.55

Hazardous waste removal work:
Work on a state or federally designated hazardous waste site, where the worker is required to wear Level A, B or C personal protection: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, where the worker is not required to wear Level A, B, or C personal protection: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker works three days for the same employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

LABO0222-013 05/01/2009

	Rates	Fringes
LABORER		
MASON TENDER:		
Cement/Concrete.....	$ 28.55	19.42

PAIN0711-023 05/01/2009

	Rates	Fringes
Painters:		
Work on bridges (Major Bridges Designed for Commercial Navigation).....	$ 46.50	19.13

PAIN0711-024 11/01/2008

	Rates	Fringes
Painters:		
New Construction		
Brush and roller.....	$ 34.47	16.14
Spray.....	$ 37.92	16.14
Steel.....	$ 35.81	16.30
Repaint work, on projects on which no major alterations occur.		
Brush and roller.....	$ 26.67	13.80
Spray.....	$ 29.34	13.80
Steel.....	$ 27.74	13.93

SUNJ2004-030 01/02/2009

	Rates	Fringes
LABORER: Common or General.....	$ 28.82	8.46
LABORER: Pipelayer.....	$ 24.05	13.67

TEAM0560-003 05/01/2011

	Rates	Fringes
TRUCK DRIVER		
Dump Truck; Flatbed Truck...	$ 32.00	27.48
Off the Road Truck; Pickup Truck.....	$ 31.85	27.48

Hazardous waste removal work:

Work on a state or federally designated hazardous waste site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level A personal protection for any workers other than the truck driver: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level B, C or D personal protection for any workers other than the truck driver: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Decoration Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the employee has been assigned to work, or, "shapes", one day of the calendar week during which the holiday occurs.

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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0000/9999: weighted union wage rates will be published annually each January.

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WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

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* a survey underlying a wage determination
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* a conformance (additional classification and rate) ruling

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U.S. Department of Labor
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2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

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U.S. Department of Labor
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Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

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U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

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END OF GENERAL DECISION

General Decision Number: NJ130002 01/04/2013 NJ2

Superseded General Decision Number: NJ20120002

State: New Jersey

Construction Type: Highway

Counties: Bergen, Essex, Hudson, Hunterdon, Middlesex, Morris, Passaic, Somerset, Sussex, Union and Warren Counties in New Jersey.

HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/04/2013

BRNJ0002-005 05/01/2012

BERGEN, ESSEX AND HUDSON COUNTIES; HUNTERDON COUNTY (north and west of a line drawn from Clover Hill, through Reaville, through Flemington, through High Bridge, through Califon, through Fairmont, to Pottersville); MIDDLESEX COUNTY (Borough of Dunellen; Township of Edison (Town of Oak Tree only); Township of Piscataway (Town of New Market only); Borough of South Plainfield); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (north of a line drawn from the point where the Lamington River leaves the boundary line between Hunterdon and Somerset Counties; then, continuing along the Lamington River to where it becomes the North Branch of the Raritan River; then, continuing along the North Branch of the Raritan River to where it becomes Chambers Brook; then, continuing along Chambers Brook until it becomes the boundary line between the Townships of Bernards and Bridgewater; then, continuing along the boundary line between the Townships of Bernards and Bridgewater, until that boundary line intersects with Route 78; then, continuing along Route 78 until Route 78 intersects with Route 525; then, continuing along Route 525 until Route 525 intersects with the boundary line between the Townships of Bridgewater and Warren; then, continuing along the boundary line between the Townships of Bridgewater and Warren until that boundary line intersects with Route 22; then, following Route 22 until Route 22 intersects with Sebrings Mills Rd. (also known as King George Rd.); then, continuing south on Sebrings Mills Rd. until it goes over Green Brook, which is the Middlesex County line); SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Bricklayer.....	$ 36.95	25.37

Work 100 degrees F. and over:
to be paid at the rate of double time.

Work on high stacks:

22% per hour additional.

BRNJ0002-006 05/01/2012

HUNTERDON COUNTY (south and east of a line drawn from Clover Hill, through Reaville, through Flemington, through High Bridge, through Califon, through Fairmont, to Pottersville); MIDDLESEX COUNTY (does not include the Borough of Dunellen; Township of Edison (Town of Oak Tree); Township of Piscataway (Town of New Market); Borough of South Plainfield); SOMERSET COUNTY (south of a line drawn from the point where the Lamington River leaves the boundary line between Hunterdon and Somerset Counties; then, continuing along the Lamington River to where it becomes the North Branch of the Raritan River; then, continuing along the North Branch of the Raritan River to where it becomes Chambers Brook; then, continuing along Chambers Brook until it becomes the boundary line between the Townships of Bernards and Bridgewater; then, continuing along the boundary line between the Townships of Bernards and Bridgewater, until that boundary line intersects with Route 78; then, continuing along Route 78 until Route 78 intersects with Route 525; then, continuing along Route 525 until Route 525 intersects with the boundary line between the Townships of Bridgewater and Warren; then, continuing along the boundary line between the Townships of Bridgewater and Warren until that boundary line intersects with Route 22; then, continuing along Route 22 until Route 22 intersects with Sebrings Mills Rd. (also known as King George Rd.); then, continuing south along Sebrings Mills Rd. until it goes over Green Brook, which is the Middlesex County line):

	Rates	Fringes
Bricklayer.....	$ 36.95	25.37

Work 100 degrees F. and over:
to be paid at the rate of double time.

Work on high stacks:
22% per hour additional.

BRNJ0002-008 05/01/2012

BERGEN, ESSEX AND HUDSON COUNTIES; HUNTERDON COUNTY (north and west of a line drawn from Clover Hill, through Reaville, through Flemington, through High Bridge, through Califon, through Fairmont, to Pottersville); MIDDLESEX COUNTY (Borough of Dunellen; Township of Edison (Town of Oak Tree only); Township of Piscataway (Town of New Market only); Borough of South Plainfield); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (north of a line drawn from the point where the Lamington River leaves the boundary line between Hunterdon and Somerset Counties; then, continuing along the Lamington River to where it becomes the North Branch of the Raritan River; then, continuing along the North Branch of the Raritan River to where it becomes Chambers Brook; then, continuing along Chambers

Brook until it becomes the boundary line between the Townships of Bernards and Bridgewater; then, continuing along the boundary line between the Townships of Bernards and Bridgewater, until that boundary line intersects with Route 78; then, continuing along Route 78 until Route 78 intersects with Route 525; then, continuing along Route 525 until Route 525 intersects with the boundary line between the Townships of Bridgewater and Warren; then, continuing along the boundary line between the Townships of Bridgewater and Warren until that boundary line intersects with Route 22; then, continuing along Route 22 until Route 22 intersects with Sebrings Mills Rd. (also known as King George Rd.); then, continuing south on Sebrings Mills Rd. until it goes over Green Brook, which is the Middlesex County line); SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
CEMENT MASON.....	$ 36.95	25.37

Cement mason:
Epoxy, acid and latex work: $.50 per hour additional.

BRNJ0002-009 05/01/2012

HUNTERDON COUNTY (south and east of a line drawn from Clover Hill, through Reaville, through Flemington, through High Bridge, through Califon, through Fairmont, to Pottersville); MIDDLESEX COUNTY (does not include the Borough of Dunellen; Township of Edison (Town of Oak Tree); Township of Piscataway (Town of New Market); Borough of South Plainfield); SOMERSET COUNTY (south of a line drawn from the point where the Lamington River leaves the boundary line between Hunterdon and Somerset Counties; then, continuing along the Lamington River to where it becomes the North Branch of the Raritan River; then, continuing along the North Branch of the Raritan River to where it becomes Chambers Brook; then, continuing along Chambers Brook until it becomes the boundary line between the Townships of Bernards and Bridgewater; then, continuing along the boundary line between the Townships of Bernards and Bridgewater, until that boundary line intersects with Route 78; then, continuing along Route 78 until Route 78 intersects with Route 525; then, continuing along Route 525 until Route 525 intersects with the boundary line between the Townships of Bridgewater and Warren; then, continuing along the boundary line between the Townships of Bridgewater and Warren until that boundary line intersects with Route 22; then, continuing along Route 22 until Route 22 intersects with Sebrings Mills Rd. (also known as King George Rd.); then, continuing south along Sebrings Mills Rd. until it goes over Green Brook, which is the Middlesex County line):

	Rates	Fringes
CEMENT MASON.....	$ 36.95	25.37

Cement mason:
Epoxy, acid and latex work: $.50 per hour additional.

CARP0006-008 11/01/2012

	Rates	Fringes
CARPENTER.....	$ 41.49	56%

CARP1456-002 05/01/2008

	Rates	Fringes
Piledriver		
Concrete form work.....	$ 37.00	27.02
All other work.....	$ 37.00	32.90

Work on land pile driving, while handling and working with creosote and creosote-impregnated products: $.25 per hour additional.

Work on hazardous/toxic/contaminated waste removal, on a hazardous/toxic/contaminated waste site, where the worker comes into contact with hazardous/toxic/contaminated waste material, and when A, B or C personal protective equipment is required and used for respiratory, skin or eye protection: 20% per hour additional.

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* ELEC0102-001 06/03/2012

HUNTERDON COUNTY (Townships of Alexandria and Bethlehem; Boroughs of Bloomsbury and Califon; Town of Clinton; Township of Clinton; Township of Delaware (west of a line following County Route 523 from the Delaware River north to the Raritan Township line); Township of East Amwell (east of State Hwy. 31); Township of Franklin; Boroughs of Frenchtown, Glen Gardner, Hampton and High Bridge; Townships of Holland and Kingwood; Borough of Lebanon; Township of Lebanon; Borough of Milford; Township of Raritan (east of State Hwy. 31 and north of County Route 523); Townships of Readington, Tewksbury and Union); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (does not include the Township of Franklin east of a line following Cedar Grove Lane from the Raritan River, in a southwesterly direction, to the Millstone Branch of the Pennsylvania Railroad; then, west along the railroad to the Delaware and Raritan Canal; then, south along the canal to the Middlesex County line; does not include the Township of Montgomery west and south of a line following U.S. Hwy. 206 (formerly State Hwy. 31) north from the Mercer County line to Harlingen Rd.; then, west along Harlingen Rd. and the Dutchtown-Zion road to the Hillsborough township line); SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Line construction:		

High-tension pipe-type
cable installation:

Cable splicer	$ 53.99	55%
Ground person	$ 26.496	51%
Groundman	$ 29.45	55%
Line technician; equipment operator; x-ray technician; equipment repair person; equipment service person; hole-digging equipment operator; truck with winch or pole and steel hand; truck without winch	$ 49.08	55%
Line technician-welder	$ 51.53	55%
Lineman; equipment operator; x-ray technician; equipment repair person; equipment service person; hole-digging equipment operator; truck with winch or pole and steel hand; truck without winch	$ 47.12	54%

All other work:

Cable splicer	$ 53.99	55%
Ground person	$ 26.496	51%
Groundman	$ 29.45	55%
Line technician; equipment operator	$ 44.16	51%
Line technician-welder	$ 51.53	55%
Lineman; equipment operator	$ 49.08	55%

Work with, or the removal of, asbestos materials: 114% times the journeyman rate.

ELEC0102-002 06/04/2012

HUNTERDON COUNTY (Townships of Alexandria and Bethlehem; Boroughs of Bloomsbury and Califon; Town of Clinton; Township of Clinton; Township of Delaware (west of a line following County Route 523 from the Delaware River north to the Raritan Township line); Township of East Amwell (east of State Hwy. 31); Township of Franklin; Boroughs of Frenchtown, Glen Gardner, Hampton and High Bridge; Townships of Holland and Kingwood; Borough of Lebanon; Township of Lebanon; Borough of Milford; Township of Raritan (east of State Hwy. 31 and north of County Route 523); Townships of Readington, Tewksbury and Union); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (does not include the Township of Franklin east of a line following Cedar Grove Lane from the Raritan River, in a southwesterly direction, to the Millstone Branch of the Pennsylvania Railroad; then, west along the railroad to the Delaware and Raritan Canal; then, south along the canal to the Middlesex County line; does not include the Township of Montgomery west and south of a line following U.S. Hwy. 206 (formerly State

Hwy. 31) north from the Mercer County line to Harlingen Rd.; then, west along Harlingen Rd. and the Dutchtown-Zion road to the Hillsborough township line); SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Electricians:		
All other work:		
Cable Splicer.....	$ 53.99	55.0%
Electrician.....	$ 48.93	55.5%

Work forty ft. or more above the ground or protective rigging (does not apply to pole work, or to use of a manlift or high reach-type lift): 10% per hour additional.

Work with, or the removal of, asbestos materials: 114% times the journeyman rate.

ELEC0164-002 06/04/2012

BERGEN, ESSEX AND HUDSON COUNTIES:

	Rates	Fringes
Electricians:		
Electrician.....	$ 47.69	62%
All other work:		
Cable splicer.....	$ 47.69	62%

Work on line voltage of 440 or 480 volts: 10% per hour additional.

Work from trusses, scaffolds, frames, ladders and poles, 40 ft. or more above the ground or floor (does not include work from a manlift): 20% per hour additional.

Work on radio towers, transmission towers and smokestacks: 21% per hour additional.

ELEC0164-010 06/02/2008

BERGEN, ESSEX AND HUDSON COUNTIES:

	Rates	Fringes
Line construction:		
Cable splicer.....	$ 54.00	54%
Groundman (includes empty conduit installations on roadways).....	$ 30.75	54%
Layout Man.....	$ 50.03	54%
Lineman; lineman-welder; x-ray technician; equipment repairman; equipment serviceman.....	$ 45.90	54%

Work on live wires of 440 or 480 volts: 10% per hour additional.

Work on radio towers, transmission towers and smokestacks: 21% per hour additional.

ELEC0269-010 10/01/2012

HUNTERDON COUNTY (Township of Delaware (east of a line following County Route 523 from the Delaware River north to the Raritan Township line); Township of East Amwell (west of State Hwy. 31); Borough of Flemington; City of Lambertville; Township of Raritan (west of State Hwy. 31 and south of County Route 523); Borough of Stockton; Township of West Amwell); SOMERSET COUNTY (Township of Montgomery (west and south of a line following U.S. Hwy. 206 (formerly State Hwy. 31) north from the Mercer County line to Harlingen Rd.; then, west along Harlingen Rd. and the Dutchtown-Zion road to the Hillsborough township line):

	Rates	Fringes
Electrician.....	$ 47.34	61.48% + .25

ELEC0269-013 10/01/2006

HUNTERDON COUNTY (Township of Delaware (east of a line following County Route 523 from the Delaware River north to the Raritan Township line); Township of East Amwell (west of State Hwy. 31); Borough of Flemington; City of Lambertville; Township of Raritan (west of State Hwy. 31 and south of County Route 523); Borough of Stockton; Township of West Amwell); SOMERSET COUNTY (Township of Montgomery (west and south of a line following U.S. Hwy. 206 (formerly State Hwy. 31) north from the Mercer County line to Harlingen Rd.; then, west along Harlingen Rd. and the Dutchtown-Zion road to the Hillsborough township line):

	Rates	Fringes
Line construction:		
Continuous pipe-type underground oil-filled transmission conduit installations:		
Ground person; truck with winch operator.....	$ 35.58	47.3%
Line technician; cable splicer; heavy equipment operator.....	$ 44.48	47.3%
All other work:		
Ground person; truck with winch operator.....	$ 35.58	47.3%
Line technician; cable		

splicer; heavy equipment
operator.....$ 44.48 47.3%

ELEC0456-001 06/04/2012

MIDDLESEX COUNTY; SOMERSET COUNTY (Township of Franklin (east of a line following Cedar Grove Lane from the Raritan River, in a southwesterly direction, to the Millstone Branch of the Pennsylvania Railroad; then, west along the railroad to the Delaware and Raritan Canal; then, south along the canal to the Middlesex County line)):

	Rates	Fringes
Electricians:		
Cable splicer	$ 50.48	66%
Electrician	$ 45.50	67.25%

Work on line voltage of 440 volts and over: 10% per hour additional.

Work from trusses, scaffolds and ladders 40 ft. or more from the ground or floor; or under air pressure; or over conveyors or moving equipment or machinery: 10% per hour additional.

ELEC0456-002 06/04/2012

MIDDLESEX COUNTY; SOMERSET COUNTY (Township of Franklin (east of a line following Cedar Grove Lane from the Raritan River, in a southwesterly direction, to the Millstone Branch of the Pennsylvania Railroad; then, west along the railroad to the Delaware and Raritan Canal; then, south along the canal to the Middlesex County line)):

	Rates	Fringes
Line construction:		
Continuous pipe-type underground oil-filled transmission conduit installations:		
Cable splicer	$ 50.48	66%
Crane Operator	$ 50.48	66%
Groundman (when installing conduit on public roadways)	$ 26.80	66%
Groundman; winch operator	$ 43.88	66%
Line technician; x-ray technician; equipment repair person; equipment serviceperson; electrical installation worker; hole-digging equipment operator; truck operator		

with winch or pole; truck operator without winch.....	$ 44.67	66%
All other work:		
Cable splicer.....	$ 50.48	66%
Crane Operator.....	$ 50.48	66%
Groundman (when installing conduit on public roadways).....	$ 26.80	66%
Groundman43.98; winch operator.....	$ 43.88	66%
Line technician.....	$ 45.50	67.25%

ENGI0825-004 07/01/2012

	Rates	Fringes
Power equipment operators:		
Steel erection:		
GROUP 1.....	$ 46.04	27.25
GROUP 2.....	$ 44.38	27.25
GROUP 3.....	$ 44.65	27.25
GROUP 4.....	$ 40.59	27.25
GROUP 5.....	$ 38.93	27.25
GROUP 6.....	$ 37.40	27.25
GROUP 7.....	$ 35.64	27.25

Hazardous waste removal work:
Work on a state or federally designated hazardous waste site; where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: 20% per hour additional.

PAID HOLIDAYS:
New Year's Day, Washington's Birthday observed, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided 1) that the worker works three of the preceding five work days before the holiday; or, the work day before the holiday and the work day after the holiday; and, 2) that the worker works the work day before and the work day after the holiday.

DEFINITION OF GROUPS:

GROUP 1:
Cranes (all cranes, land or floating with boom including jib, 140 ft. and over, above ground); derricks (all derricks, land, floating or Chicago boom type with boom including jib, 140 ft. and over, above ground)

GROUP 2:
Cranes (all cranes, land or floating with boom including jib, less than 140 ft. above ground); derricks (all derricks, land, floating or Chicago boom type with boom

including jib, less than 140 ft. above ground)

GROUP 3:
Helicopter pilot

GROUP 4:
"A" frame; cherry picker (10 ton and under); hoist (all types of hoist, including steam, gas, diesel, electric, air, hydraulic, single and double drum, concrete, brick shaft caisson, or any other similar type of hoisting machine, portable or stationary, except Chicago boom type); jack (screw, air, hydraulic power-operated unit or console type (not hand jack or pile load test type); side boom; straddle carrier

GROUP 5:
Aerial platform used as a hoist; compressor, two or three in battery; directional boring machine; elevator or house car; concrete cleaning/decontamination machine operator, decontamination and remediation work only; conveyor and tugger hoist; firefighter; forklift; generator, two or three in battery; heavy equipment robotic operator/technician, decontamination and remediation work only; maintenance, utility person; master environmental maintenance technician, decontamination and remediation work only; rod bending machine (power); ultra high-pressure waterjet cutting tool system operator/maintenance technician, decontamination and remediation work only; vacuum blasting machine operator/maintenance technician, decontamination and remediation work only; welding machine (gas or electric, two or three in battery, including diesel); captain, power boat; tug master, power boat; oiler, with either one compressor or one welding machine

GROUP 6:
Compressor, single; off-road back dump; welding machine (single, gas, diesel and electric converters of any type); welding system, multiple (rectifier, transformer type); generator, single

GROUP 7:
Oiler; deckhand

ENGI0825-009 07/01/2012

	Rates	Fringes
Power equipment operators:		
GROUP 1	$ 42.02	27.25
GROUP 2	$ 40.43	27.25
GROUP 3	$ 38.52	27.25
GROUP 4	$ 36.89	27.25
GROUP 5	$ 35.18	27.25
GROUP 6	$ 43.84	27.25

Hazardous waste removal work:
Work on a state or federally designated hazardous waste

site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: 20% per hour additional.

PAID HOLIDAYS:

New Year's Day, Washington's Birthday observed, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided 1) that the worker works three of the preceding five work days before the holiday; or, the work day before the holiday and the work day after the holiday; and, 2) that the worker works the work day before and the work day after the holiday.

DEFINITION OF GROUPS:

GROUP 1:

Autograde - combination subgrader; base metal spreader and base trimmer (CMI and similar types); autograde placer - trimmer spreader combination (CMI and similar types); autograde slipform paver (CMI and similar types); backhoe; central power plant (all types); concrete paving machine; crane (all types, including overhead and straddle traveling type); crane, gantry; derrick (land, floating or Chicago boom type); drillmaster, quarrymaster (down-the-hole drill, rotary drill, self-propelled hydraulic drill, self-powered drill); dragline; elevating grader; front end loader (5 cu. yd. and over); gradall; grader, raygo; locomotive (large); mucking machine; pavement and concrete breaker (superhammer and hoe ram); pile driver (length of boom, including length of leads, shall determine premium rate applicable); roadway surface grinder; scooper (loader and shovel); shovel; tree chopper with boom; trench machine (cable plow)

GROUP 2:

"A" frame/backhoe combination; boom attachment on loader (rate based on size of bucket, not applicable to pipehook); boring and drilling machine; brush chopper, shredder and tree shredder; carryall; concrete pump; concrete pumping system, pumpcrete and similar type; conveyor, 125 ft. and over; drill doctor, including dust collecting and maintenance work); front end loader (2 cu. yd. but less than 5 cu. yd.); grader (finish); groove cutting machine (ride-on type); heater planer; hoist (all types of hoist, shall also include steam, gas, diesel, electric, air, hydraulic, single and double drum, concrete, brick shaft caisson, snorkel roof, and/or any other similar type hoisting machine, portable or stationary, except Chicago boom type) (if hoist is "outside material tower hoist", long boom rate is to be applied); hydraulic crane, 10 tons and under; hydro-axe; hydro-blaster; jack (screw, air, hydraulic power-operated unit or console type (not hand jack or pile load test type); log skidder; pan; pavers (all) (concrete); plate and frame filter press; pumpcrete

machine; squeezecrete; concrete pump (regardless of size); scraper; side boom; straddle carrier, Ross and similar type; whip hammer; winch truck (hoisting)

GROUP 3:

Asphalt curbing machine; asphalt plant engineer; asphalt spreader; autograde tube finishing and texturing machine (CMI and similar types); autograde curecrete machine (CMI and similar types); autograde curb trimmer and sidewalk, shoulder, slipform (CMI and similar types); bar bending machine (power); batcher; batching plant and crusher on site; belt conveyor system; boom-type skimmer machine; bridge deck finisher; bulldozers (all); car dumper (railroad); compressor and blower-type unit (used independently or mounted on dual-purpose truck, on jobsite or in conjunction with jobsite, in loading and unloading of concrete, cement, fly ash, instantcrete, or similar type materials); compressor (2 or 3) (in battery) (within 100 ft.); concrete cleaning/decontamination machine operator, when used for decontamination and remediation; concrete finishing machine; concrete saw and cutter (ride-on type); concrete spreader, hetzel, rexomatic and similar type; concrete vibrator; conveyor, under 125 ft.; crushing machine; directional boring machine; ditching machine, small (Ditchwitch, Vermeer or similar type); dope pot (mechanical with or without pump); dumpster; elevator; firefighter; forklift (Economobile, Lull and similar type of equipment); front end loader (1 cu. yd. and over but less than 2 cu. yd.); generator (2 or 3) (in battery) (within 100 ft.); giraffe grinder; grader and motor patrol; gunite machine (does not include nozzle); hammer, vibratory (in conjunction with generator); heavy equipment robotic operator/technician, when used for decontamination and remediation; hoist (roof, tugger, aerial platform hoist and house cars); hopper; hopper door (power-operated); ladder (motorized); laddervator; locomotive, dinky type; maintenance, utility person; master environmental maintenance technician, when used for decontamination and remediation; mechanic; mixer (except paving mixer); pavement breaker, small, self-propelled ride-on type (also maintains compressor on hydraulic unit); pavement breaker, truck-mounted; pipe bending machine (power); pitch pump; plaster pump, regardless of size; posthole digger (post pounder and auger); rod bending machine (power); roller, blacktop; scale, power; seaman pulverizing mixer; shoulder widener; silo; skimmer machine (boom type); steel cutting machine, servicing and maintaining; tractor; captain, power boat; tug master, power boat; ultra high-pressure waterjet cutting tool system operator/maintenance technician, when used for decontamination and remediation; vacuum blasting machine operator/maintenance technician, when used for decontamination and remediation; vibrating plant (used in conjunction with unloading); welder and repair mechanic

GROUP 4:

Broom and sweeper; chipper; compressor (single); concrete spreader (small type); conveyor loader (does not include

elevating grader); engine, large diesel (1620 H.P.) and staging pump; farm tractor; fertilizing equipment (operation and maintenance of); fine grade machine (small type); form line grader (small type); front end loader (under 1 cu. yd.); generator (single); grease, gas, fuel and oil supply truck; heater (Nelson or other type including propane, natural gas or flow-type unit); lights (portable generating light plant); mixer, concrete, small; mulching equipment (operation and maintenance of); off-road back dump; pump (4-in. suction and over, including submersible pump); pump (diesel engine and hydraulic) (immaterial of power); road finishing machine (small type); roller, grade, fill or stone base; seeding equipment (operation and maintenance of); sprinkler and water pump truck; steam jenny and boiler; stone spreader; tamping machine, vibrating ride-on; temporary heating plant (Nelson or other type, including propane, natural gas or flow-type unit); welding machine (gas, diesel, and/or electric converter of any type) (single, or two or three in a battery) (within 100 ft.); welding system, multiple (rectifier, transformer type); wellpoint system

GROUP 5:
Oiler; tire repair and maintenance

GROUP 6:
Helicopter pilot; helicopter engineer

IRON0011-002 01/01/2012

BERGEN, ESSEX, HUDSON AND HUNTERDON COUNTIES; MIDDLESEX COUNTY (north half); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (north half); SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Ironworkers:		
Reinforcing	$ 36.04	39.10
Structural	$ 38.84	39.10

IRON0036-003 07/01/2009

WARREN COUNTY

	Rates	Fringes
Ironworkers:	$ 34.05	22.42

IRON0068-004 07/01/2011

MIDDLESEX COUNTY (south half); SOMERSET COUNTY (south half):

	Rates	Fringes
Ironworker	$ 34.35	18.78

Hazardous waste removal work, on a state or federally designated hazardous waste site, where the worker is required to wear Level A, B or C personal protection: $3.00 per hour additional.

LABO0172-005 03/01/2011

	Rates	Fringes
Laborers:		
GROUP 1	$ 32.20	21.55
GROUP 2	$ 32.90	21.55
GROUP 3	$ 33.15	21.55
GROUP 4	$ 36.70	21.55

Hazardous waste removal work:
Work on a state or federally designated hazardous waste site, where the worker is required to wear Level A, B or C personal protection: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, where the worker is not required to wear Level A, B, or C personal protection: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker works three days for the same employer within a period of ten working days consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

DEFINITION OF GROUPS:

GROUP 1:
Basic laborer; landscape laborer; railroad track laborer; utility meter installer; traffic director/flag person; salamander tender; pit person; dump person; asphalt laborer (only in Bergen, Essex, Hudson and Hunterdon Counties; Middlesex County (north of the Raritan River); Morris, Passaic, Somerset, Sussex, Union and Warren Counties); slurry seal laborer (only in Bergen, Essex, Hudson and Hunterdon Counties; Middlesex County (north of the Raritan River); Morris, Passaic, Somerset, Sussex, Union and Warren Counties); raker and tamper on cold patch work; wrapper and coater of pipe; waterproofing laborer; timber person; powder carrier; magazine tender; signal person; power buggy operator; tree cutter; and the operation of such other basic power tools used to perform work usually done manually by laborers

GROUP 2:
Pipelayer; laser person; conduit and duct line layer; jackhammer; chipping hammer; pavement breaker; concrete

cutter; asphalt cutter; sheet hammer operator; sandblasting, acetylene cutting and burning; wagon drill operator; directional drill operator; hydraulic drill operator; drill master; core driller; traffic control coordinator; asphalt raker/lute person (only in Bergen, Essex, Hudson and Hunterdon Counties; Middlesex County (north of the Raritan River); Morris, Passaic, Somerset, Sussex, Union and Warren Counties); walk-behind saw cutter

GROUP 3:
Finisher; rammer; setter of brick or stone pavers; hardscaping; gunite nozzle person; stonecutter; form setter; manhole; catch basin and inlet builder; asphalt screedperson (only in Bergen, Essex, Hudson and Hunterdon Counties; Middlesex County (north of the Raritan River); Morris, Passaic, Somerset, Sussex, Union and Warren Counties)

GROUP 4:
Blaster

LABO0172-006 03/01/2011

MIDDLESEX COUNTY (south of the Raritan River):

	Rates	Fringes
Laborers:		
ASPHALT WORK:		
GROUP 1	$ 33.00	21.55
GROUP 2	$ 32.60	21.55
GROUP 3	$ 32.85	21.55
GROUP 4	$ 32.70	21.55
GROUP 5	$ 32.90	21.55

PAID HOLIDAYS:
New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker works three days for the same employer within a period of ten working days, consisting of five working days before and five working days after the day upon which the holiday falls or is observed.

DEFINITION OF GROUPS:

GROUP 1:
Head raker

GROUP 2:
Painter, shoveler, roller person, kettle person, smother person, tamper

GROUP 3:
Raker, screed person, lute person

GROUP 4:
Milling controller

GROUP 5:
Traffic control coordinator

PAIN0711-009 05/01/2012

	Rates	Fringes
Painters:		
Work on bridges (all bridges that span major waterways, railroad bridges, bridges over canyons, overpasses)	$ 49.78	21.25

PAIN0711-014 05/01/2011

	Rates	Fringes
Painters:		
All other work:		
Brush and roller	$ 35.99	16.86
Spray	$ 38.91	17.19

PLAS0029-001 05/01/2010

BERGEN, ESSEX, HUDSON, MORRIS, PASSAIC, SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
CEMENT MASON	$ 40.00	21.75

Cement masons:
Work on suspended staging, not supported from the ground:
$.50 per hour additional.

PLAS0592-030 05/01/2012

HUNTERDON, MIDDLESEX, SOMERSET AND UNION COUNTIES:

	Rates	Fringes
Cement mason	$ 38.37	28.56

TEAM0408-001 05/01/2011

ESSEX, MORRIS, SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Truck drivers:		
Group 1	$ 33.80	17.36+a
Group 2	$ 33.70	17.36+a

Group 3.....	$ 33.60	17.36+a
Group 4.....	$ 33.55	17.36+a

a. Employer contributes $1472.15 per month per worker for health and welfare.

Hazardous waste removal work, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: $3.00 per hour additional.

Hazardous waste removal work, where the worker is working in a hazardous waste site, in a zone requiring Level A personal protection for any of the workers: $3.00 per hour additional.

Hazardous waste removal work, where the worker is not working in a zone requiring Level A, B or C personal protection: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Decoration Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker has been assigned to work, or, "shapes", one day of the calendar week during which the holiday occurs.

DEFINITION OF GROUPS:

GROUP 1:
Winch trailer driver

GROUP 2:
Drivers of all Euclid-type vehicles: Euclid, International Harvester, Wabco, Caterpillar, Koehring, tractor and wagon; dumpster; bottom, rear and side dump; carry-all and scraper (not self-loading, loading over the top); water sprinkler trailer; water pull and similar types of vehicle; driver of tractor and trailer-type vehicles: flat, float, I-beam, low bed, water sprinkler, bituminous, transit mix, road oil, fuel, bottom dump hopper, rear dump, office, shanty, epoxy, asphalt, agitator mixer, mulching, stringing, seeding, fertilizing, pole, spread bituminous distributor, water pull (entire unit), tractor trailer, reel trailer and similar types of vehicle

GROUP 3:
Driver on straight three-axle materials: truck and float

GROUP 4:
Truck driver; driver of the following types of vehicles: dump, flat, float, pick-up, container hauler, fuel, water sprinkler, road oil, stringer bead, hot pass, bus, dumpcrete, transit mixer, agitator mixer, half track, winch truck, side-o-matic, dynamite, powder, x-ray, welding, skid, jeep, station wagon, A-frame, dual purpose truck,

truck with mechanical tailgate, asphalt distributor, batch truck, seeding, mulching, fertilizing, air compressor truck (in transit); parts chaser; escort; scissor; hi-lift; telescope; concrete breaker; gin pole; stone, sand, asphalt distributor and spreader; nipper; fuel truck (driver of fuel truck including handling of hose and nozzle - entire unit); team driver; vacuum or vac-all truck (entire unit); skid truck (debris container - entire unit); concrete mobile truck (entire unit); beltcrete truck; pumpcrete truck; line truck; reel truck; wrecker or tow truck; utility truck; tack truck; lift truuk; cardex person; drivers on the following types of vehicle: Broyhill coal tar epoxy truck, Littleford bituminous distributor, slurry seal truck or vehicle, thiokol track master pick-up (swamp cat pick-up), bucket loader, dump truck and any rubber-tired tractor used in pulling and towing farm wagons and trailers of any description; on-site repair shop

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TEAM0469-001 05/01/2011

HUNTERDON, MIDDLESEX AND SOMERSET COUNTIES; UNION COUNTY (south of Wood Ave.); WARREN COUNTY:

	Rates	Fringes
Truck drivers:		
Group 1	$ 34.85	24.385
Group 2	$ 34.75	24.385
Group 3	$ 34.65	24.385
Group 4	$ 34.60	24.385

Hazardous waste removal work, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: $3.00 per hour additional.

Hazardous waste removal work, where the worker is working in a hazardous waste site, in a zone requiring Level A personal protection for any of the workers: $3.00 per hour additional.

Hazardous waste removal work, where the worker is not working in a zone requiring Level A, B or C personal protection: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Decoration Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker has been assigned to work, or, "shapes", one day of the calendar week during which the holiday falls.

DEFINITION OF GROUPS:

GROUP 1:
Winch trailer driver

GROUP 2:
Drivers of all Euclid-type vehicles: Euclid, International Harvester, Wabco, Caterpillar, Koehring, tractor and wagon; dumpster; bottom, rear and side dump; carry-all and scraper (not self-loading, loading over the top); water sprinkler trailer; water pull and similar types of vehicle; driver of tractor and trailer-type vehicles: flat, float, I-beam, low bed, water sprinkler, bituminous, transit mix, road oil, fuel, bottom dump hopper, rear dump, office, shanty, epoxy, asphalt, agitator mixer, mulching, stringing, seeding, fertilizing, pole, spread bituminous distributor, water pull (entire unit), tractor trailer, reel trailer and similar types of vehicle

GROUP 3:
Driver on straight three-axle materials: truck and float

GROUP 4:
Truck driver; driver of the following types of vehicles: dump, flat, float, pick-up, container hauler, fuel, water sprinkler, road oil, stringer bead, hot pass, bus, dumpcrete, transit mixer, agitator mixer, half track, winch truck, side-o-matic, dynamite, powder, x-ray, welding, skid, jeep, station wagon, A-frame, dual purpose truck, truck with mechanical tailgate, asphalt distributor, batch truck, seeding, mulching, fertilizing, air compressor truck (in transit); parts chaser; escort; scissor; hi-lift; telescope; concrete breaker; gin pole; stone, sand, asphalt distributor and spreader; nipper; fuel truck (driver of fuel truck including handling of hose and nozzle - entire unit); team driver; vacuum or vac-all truck (entire unit); skid truck (debris container - entire unit); concrete mobile truck (entire unit); beltcrete truck; pumpcrete truck; line truck; reel truck; wrecker or tow truck; utility truck; tack truck; lift truuk; cardex person; drivers on the following types of vehicle: Broyhill coal tar epoxy truck, Littleford bituminous distributor, slurry seal truck or vehicle, thiokol track master pick-up (swamp cat pick-up), bucket loader, dump truck and any rubber-tired tractor used in pulling and towing farm wagons and trailers of any description; on-site repair shop

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TEAM0560-001 05/01/2011

BERGEN, HUDSON AND PASSAIC COUNTIES:

	Rates	Fringes
Truck drivers:		
Group 1	$ 31.85	27.48
Group 2	$ 31.90	27.48
Group 3	$ 32.00	27.48
Group 4	$ 32.10	27.48

Hazardous waste removal work:

Work on a state or federally designated hazardous waste site, where the worker is in direct contact with hazardous material, and when personal protective equipment is required for respiratory, skin and eye protection: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level A personal protection for any workers other than the truck driver: $3.00 per hour additional.

Work on a state or federally designated hazardous waste site, in a zone requiring Level B, C or D personal protection for any workers other than the truck driver: $1.00 per hour additional.

PAID HOLIDAYS:
New Year's Day, President's Day, Decoration Day, Independence Day, Labor Day, Presidential Election Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the employee has been assigned to work, or, "shapes", one day of the calendar week during which the holiday occurs.

DEFINITION OF GROUPS:

GROUP 1:
Driver of the following types of vehicle: dump; flat; float; pick-up; container hauler; fuel; water sprinkler; road oil; stringer bead; hot pass; bus; dumpcrete; transit mixer; agitator mixer; half track; winch truck; side-o-matic; dynamite; powder; x-ray; welding; skid; jeep; station wagon; stringer; A-frame; dual-purpose truck; truck with mechanical tailgate; asphalt distributor; batch truck; seeding; mulching; fertilizing; air compressor truck (in transit); parts chaser; escort; scissor; hi-lift; telescope; concrete breaker; gin pole; stone, sand, asphalt distributor and spreader; nipper; fuel truck (driver of fuel truck including handling of hose and nozzle - entire unit); team driver; vacuum or vac-all trucks (entire unit); skid truck (debris container - entire unit); concrete mobile truck (entire unit); beltcrete truck; pumpcrete truck; line truck; reel truck; wrecker; tow truck; utility truck; tack truck; cardex person; driver on the following types of vehicle: Broyhill coal tar epoxy truck, Littleford bituminous distributor, slurry seal truck or vehicle, thiokol track master pick-up (swamp cat pick-up); bucket loader dump truck and any rubber-tired tractor used in pulling and towing farm wagons and trailers of any description; on-site repair shop

GROUP 2:
Driver of 3-axle materials truck and float

GROUP 3:
Driver of all Euclid-type vehicles: Euclid; International Harvester; Wabco; Caterpillar; Koehring, tractor and wagon; dumpster; dump; bottom, rear and side dump; carry-all and scraper (not self-loading, loading over the top); water sprinkler trailer; water pull and similar types of vehicle; driver of tractor and trailer-type vehicle: flat, float, I-beam, low bed, water sprinkler, bituminous, transit mix, road oil, fuel, bottom dump hopper, rear dump, office, shanty, epoxy, asphalt, agitator mixer, mulching, stringing, seeding, fertilizing, pole, spread bituminous distributor, water pull (entire unit), tractor trailer, reel trailer, and similar types of vehicle

GROUP 4:
Winch trailer driver

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

Revised 12/17/2008

THE PORT AUTHORITY OF NY & NJ

Certification Application for the Minority and Women-owned Business Enterprise Program

PLEASE PRINT OR TYPE CLEARLY

General Instructions:

- DO NOT LEAVE ANY SPACES BLANK ON THE APPLICATION - if a question is not applicable to your business insert "N/A" in the space provided for your answer
- Whenever the space is insufficient to answer the questions completely, attach additional sheets as necessary. Use the question number to identify any answer continued on an additional sheet
- For questions, call the Certification Helpline at 212-435-7808 or E-mail objocert@panynj.gov.
- *Once you have completed the application, please return it and all required documentation to:*

The Port Authority of NY & NJ
Office of Business & Job Opportunity - Certification Unit
233 Park Avenue South, 4th floor
New York, NY 10003

SECTION I: MAIN COMPANY INFORMATION

1. Business Name

Legal name of company applying to be certified

2. D.B.A.

"Doing Business As"- Complete if company does business under a name which is different from its legal name.

3. Business Address (must represent a physical location; cannot be a Post Office Box)

Street Address | Suite / Apt / Room/ Unit

City | State | Zip/Zip+4

County

4. Business Mailing Address (complete only if different from the address given in Question 3)

Street Address | Suite / Apt / Room/ Unit

City | State | Zip/Zip+4

5. Business Phone ( ) ---

5a. Business Fax ( ) ---

6. Business Website

7. Your E-mail Address

7a. Your Cell Phone Number ( )

8. Federal EIN or SSN

Schedule A

9. Name/title of an authorized representative to contact during the application review process:

Mr./Miss/Mrs./Ms. First Name : Last Name

Title Phone Ext. E-Mail Address

10. This company is applying for certification as ("X"all that apply)

Minority-owned Business Enterprise (MBE) ☐

Women-owned Business Enterprise (WBE) ☐

Refer to page _____ of the Application Guidelines to determine the appropriate designation for your company.

11. Are you currently involved in the bidding process or other contract/purchase order negotiations with the Port Authority or Port Authority tenants?

Yes_____ No_____

If "Yes", identify the department within the Port Authority and/or name of tenant and contact name

12. Has your company ever applied for certification as an M/W/SBE, or a DBE (whether SBA 8(a), Transportation, or other) with another governmental agency, department, or authority?

Yes_____ No_____

If "Yes", provide the following details

Name of Governmental Entity	Program (MBE, WBE, SBE, DBE)	Status (Pending, Certified, Decertified, Denied, Rejected, Revoked, On Appeal)	Date (mm/yy)

13. How did you first hear about The Port Authority of NY & NJ's M/W/DBE Certification program(s)? (please choose only one)

Letter/Call/E-mail ☐

Port Authority Web site ☐

Event ☐

Please specify name or sponsor of event and date

Other ☐

Please specify what and when

SECTION II: COMPANY OWNERSHIP

14. Business Structure

Sole Proprietorship	☐	Partnership (including LLP)	☐
Limited Liability Company (LLC)	☐	Corporation (including S-Corp.)	☐

15. Date company was established _____/ _____/ _____

16. Has the business existed under a different type of business structure prior to the Date *Established indicated in question? 16*

Yes_____ No_____

If "Yes", please provide copy of original Business Certificate

17. Has your Certificate of Incorporation, Business Certificate, or Certificate of Trade Name been amended?

Yes_____ No_____

If "Yes", please provide copy of amended Business Certificate

18. Method of Business Origination or Acquisition (check all applicable)

Started New Business	☐	Secured Franchise	☐
Bought Existing Business	☐	Secured Concession	☐
Merger or Consolidation	☐	Inherited Business	☐

Other ☐ _____

19. Date of origination (or acquisition, if later) _____/ _____/ _____

For the remaining questions in Section II which ask for ethnic identification of owners, shareholders, officers, board members, and managers, please use the following group codes to identify the ethnicity of each individual where required.

01	Black	02c	Spanish	04	Native American
02a	Hispanic	03a	Asian-Pacific	05	White (Non-Minority)
02b	Portuguese	03b	Asian-Indian	06	Other

20. Please provide the following information for all person(s) with ownership interest in the company (all proprietors, partners, and members OR, in the case of a corporation, all shareholders).

Name (First and Last)	Position In Company	% Owned	Date Ownership Established (mm/yy)	Gender (M/F)	Ethnicity (see group code table)	US Citizen or Permanent Resident Alien (Y/N)

*** QUESTIONS 22-24 APPLY ONLY TO CORPORATIONS. *** *** IF YOUR COMPANY IS NOT A CORPORATION, SKIP TO QUESTION 25 ***

21. If the company is a corporation, please provide the following information for all shareholders identified in Question 21

Name (First and Last)	Position In Company	Number of Shares Owned	Unit Share Price Paid When Purchased

22. State the number of company shares in each of the following

Common Authorized _____ Common Issued _____

Preferred Authorized _____ Preferred Issued _____

23. Name and position of current Officers and/or Board of Directors

Name (First and Last)	Position	Position Effective Date (mm/yy)	Gender (M/F)	Ethnicity (see group code table)

** ALL APPLICANTS SHOULD RESUME COMPLETING THE APPLICATION HERE **

24. Please identify the capital contributions to the company by each person identified in Question 21, including cash, equipment, property, and expertise

Name (First and Last)	Type of Contribution	Total Dollar Value	Date of Contribution (mm/yy)

25. If your company is owned in whole or in part by another company, please identify the company and the percentage of ownership interest. Include venture capitalists and other similar investors

Company Name	Percentage Owned	Date Ownership Established (mm/yy)

SECTION III: COMPANY MANAGEMENT

26. Identify individuals responsible for managerial operations (*state if owner or non-owner*). Refer to group code definitions on prior page.

Name & Title	Gender (M/F)	Group Code	Owner? (Y/N)
a) Financial Decisions			
b) Estimating			
c) Preparing Bids			
d) Negotiating Bonding			
e) Marketing & Sales			
f) Hiring & Firing			
g) Supervising Field Operations			
h) Purchasing Equipment/Supplies			
i) Managing & Signing Payroll			
j) Negotiating Contracts			
k) Signatures for Business Accounts			

27. Do any principals, officers, employees and/or owners of the firm have an affiliation, i.e. business interest or employment with any other firm?

Yes_____ No_____ (If "Yes", complete the following)

Name (First and Last)	Name and Address of Affiliated Firm	Nature of Business	Nature of Affiliation

28. Number of Employees (if necessary, average over the past year)

Permanent		Temporary		Field	
Full-Time	_____	Full-Time	_____	Full-Time	_____
Part-Time	_____	Part-Time	_____	Part-Time	_____

SECTION IV: COMPANY FINANCES

29. Does your company have a Line of Credit?

Yes_____ No_____ If "Yes", please provide details:

_____

Bank Dollar Limit Name of Guarantor(s)

30. Please list all major current lenders to the company

Name of Lender	Amount of Loan	Terms of Repayment

31. Identify bank(s) where company accounts are maintained

Bank Name	Address	Contact Name	Contact Title	Type of Account

32. Please provide gross receipts (sales) for each of the last three fiscal years. (If in business for less than three years, complete as applicable)

Current Year _____ $_____

Last Year _____ $_____

Previous Year _____ $_____

SECTION V: COMPANY OPERATIONS

33. Check the industry which best describes your PRIMARY line of business

- ☐ Construction-related
- ☐ Consultants
- ☐ Consumer Service
- ☐ Manufacturer/Supplier
- ☐ Professional Service
- ☐ Purchasing
- ☐ Technical Service
- ☐ Other _____

34. If a license, permit or certification (e.g. Master Electrical License, PE for engineers, CDL for truck drivers, etc.) is required to conduct any part of your company's business, please identify the individual(s) holding the license, permit or certification and provide a copy

Name of the Holder/Registrant	Type of License/ Permit/Certification	Issued by	Issue Date (mm/yy)	Exp. Date (mm/yy)

35. Is your company bonded? Yes_____ No_____

If "Yes", please provide detail:

Name of Agent/Broker	Surety Co.	Bonding Limit	
		Single $	Aggregate $

36. Is your company insured? Yes_____ No_____ If "Yes", please provide detail:

_____

Carrier Name $ Amount of Liability Insurance

37. Please list the company's major equipment or machinery

Type	Depreciated $ Value	Acquisition Date (mm/yy)	Owned or Leased

38. List rented, leased or owned warehouse, plant and office facilities – Submit copy of lease, deed or mortgage

Facility Type	Owner or Name of Lessor and/or rental agent	Amt of yearly payment

39. Does your company share office space, personnel or equipment with any other company?

Yes_____ No_____

If "Yes", please provide details.

Company Name	Phone	Personnel (X)	Office Space ("X")	Yard Space (X)	Equipment ("X")	Machinery (X)

ACKNOWLEDGEMENTS AND VERIFICATION

FIRST, this certification application form, the supporting documents, and any other information provided in support of the application is considered part of the application. Any false statements or misrepresentations in the application may result in the applicant's disqualification from certification as Minority and/or Woman-owned Business Enterprise (M/WBE) by The Port Authority of New York and New Jersey for him/herself and its subsidiaries, which are included in the term "Port Authority".

SECOND, the information contained herein is subject to the Port Authority's Freedom of Information policy as reflected in the resolution adopted by the Committee on Operations of the Port Authority on August 13, 1992.

THIRD, the Port Authority may require further proof of eligibility for certification in addition to the information disclosed in this application and the applicant shall cooperate with the Port Authority in supplying the additional information. By completing this application, the applicant agrees to submit the additional proof required and acknowledges that the Port Authority may decide to deny the application if the additional proof is not submitted within 30 days after it is requested.

FOURTH, by filing this application, the applicant consents to examination of its books and records and interviews of its principals and employees by the Port Authority for the purpose of determining whether the applicant is, or continues to be, an eligible M/WBE. The applicant acknowledges that its certification may be denied if such examinations or interviews are refused or if the Port Authority determines, as a result of the examinations or interviews, that the applicant does not qualify for certification as a M/WBE.

FIFTH, by filing this application, the applicant consents to inquiries being directed by the Port Authority to the applicant's bonding companies, banking institutions, credit agencies, contractors, clients and other certifying agencies for the purpose of ascertaining the applicant's eligibility for certification. If the applicant fails to permit such inquiring to be made, such failure may be grounds for denying or revoking the applicant's certification.

SIXTH, the applicant agrees that it will advise the Port Authority of any change in the ownership or operational and managerial control of applicant's business after the certification application has been filed within 30 days of such change.

SEVENTH, certification is normally granted for a period of five (5) years. However, the Port Authority may require submission of a new application, additional information, examinations of the applicant's principals and employees at any time before the expiration of the five-year certification period. The applicant's failure to submit such material or to consent to such examinations and interviews will be grounds for revocation of certification.

EIGHT, the filing of this application, its acceptance by the Port Authority, and any subsequent certification of the applicant by the Port Authority, is not intended to and does not create any procedural or substantive rights enforceable at law by the applicant against the Port Authority, its Commissioners, officers, agents or employees and any such certification is only intended to facilitate the identification of qualified and bona fide M/WBEs.

NINTH, the Code of Ethics certification attached hereto shall be considered part of this certification application and the applicant is advised to familiarize him/herself with the terms of the certification prior to submitting this application.

TENTH, in submitting this application the applicant and each person signing on behalf of the applicant certifies that, to the best of their knowledge and belief, the following statements are true and correct:

A) No individual who is current or former employee of the Port Authority or its subsidiaries (i.e., Port Authority Trans-Hudson Corporation (PATH), Newark Legal and Communications Center Urban Renewal Corporation) other than those individuals identified in the space immediately below (1) owns an interest in; or (2) has involvement in a relationship with the applicant firm (a) from or as a result of which the individual has received within the past year, or is entitled to receive in any future year, more than $1,000 or its equivalent; or (b) which has a market value in excess of $1,000. *(List here any such current or former Port Authority Employee (s))

_____

B) No individual who is a current or former employee of the Port Authority or its subsidiaries other than those individuals identified in the space immediately below (1) holds a position in the applicant firm such as an officer, director, trustee, partner, employee, or a position of management: or (2) acts as a consultant, agent or representative of the firm in any capacity. *(List here any current or former Port Authority Employee (s))

_____

*Included within the scope of this certification are the individuals identified by the applicant in response to questions 4, 4a, 8d, 9, 10, 10a, 17, 18, 19, 24 and 25.

ELEVENTH, the criteria for certification by the Port Authority as a Small Business Enterprise are outlined in the documentation entitled "Small Business Enterprise Program (SBE) Administered by The Port Authority of New York and New Jersey" which accompanies this application. If the applicant believes that he/she is eligible for SBE certification, he/she may request that this application also be treated as
an SBE certification application by signing below. If signature is provided, all acknowledgments and provisions of this M/WBE certification shall also apply.

Applicant _____ Date _____

VERIFICATION

STATE OF _____)

SS:

COUNTY OF_____)

(A) (For Sole Proprietorships, Partnerships, and Limited Liability Partnerships)

_____, being duly sworn, states that he or she is the owner of (or a Partner in) the entity making the foregoing application and that the statements and representations made in the application are true to his/her own knowledge.

_____ _____
Signature Date

(B) (For Corporations and Limited Liability Companies)

_____, being duly sworn, states that he/she is the
Name of Corporate Officer

_____ of _____,
Title of Corporate Officer Name of Corporation

the entity making the foregoing application, that he/she has read the application and knows its contents, that the statements and representations made in the application are true to his/her knowledge, and that the application is made at the direction of the Board of Directors of the Corporation.

Corporate Seal _____
Signature Date

Sworn to before me this _____ day of _____, 20_____

_____
Notary Public

Mail to: ***The Port Authority of New York and New Jersey***
Office of Business & Job Opportunity – Certification Unit
233 Park Avenue South, 4th Floor
New York, NY 10003

CODE OF ETHICS CERTIFICATION

In signing and submitting the annexed Certification Application, each applicant and each person signing on behalf of any applicant certifies that they have not made any offers or agreements or given or agreed to give anything of value or taken any other action with respect to any employee or former employee of The Port Authority of New York and New Jersey or any of its subsidiaries (hereinafter referred to as the "Authority") or any immediate family member of either which would constitute a breach of ethical standards under the Code of Ethics and Financial Disclosure dated as of July 18, 1994 (a copy of which is available upon request to the Office of Regional and Economic Development /Business & Job Opportunity), nor do they have any knowledge of any act on the part of such employee or former employee relating either directly or indirectly to the applicant which constitutes a breach of the ethical standards set forth in said code.

> As used herein, "anything of value" shall include but not be limited to any (a) favors, such as meals, entertainment, transportation (other than that contemplated by an Authority contract), etc., which might tend to obligate the Authority employee to the Contractor and (b) gift, gratuity, money, goods, equipment, services, lodging, discounts not available to the general public, offers or promises of employment, loans or the cancellation thereof, preferential treatment or business opportunity. Such term shall not include compensation contemplated by any Authority contract.

The foregoing certification shall be deemed to have been made by the applicant as follows: If the applicant is a corporation, such certification shall be deemed to have been made not only with respect to the application itself, but also with respect to each director and officer, as well as, to the best of the certifier's knowledge and belief, each stockholder with an ownership interest in excess of 10%; if the applicant is a partnership, such certification shall be deemed to have been made not only with respect to the applicant itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate applicant, shall be deemed to have been authorized by the Board of Directors of the applicant, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the applicant cannot make the foregoing certification, the applicant shall so state and shall furnish with the application, a signed statement that sets forth in detail the reasons thereof.

The foregoing certification or signed statement shall be deemed to have been made by the applicant with full knowledge that it would become part of the records of the Authority and that the Authority will rely on its truth and accuracy in granting certification.

Applicants are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et. Seq.). Applicants are also advised that the inability to make such certification will not, in and of itself disqualify an applicant, and that in each instance the Authority will evaluate the reasons therefore provided by the applicant.

Supporting Documentation Checklist

REQUIRED FOR ALL APPLICANTS Attach copies of the following documents, as applicable. Indicate documents submitted by checking appropriate boxes. PLEASE PROVIDE COPIES OF SUPPORTING DOCUMENTS ONLY - NOT THE ORIGINALS. The minimum documentation required for certification is listed below, but is not limited to this list. A representative may request additional documents during the application review process, if warranted.

- ☐ 1 Résumés for all principals, partners, officers and/or key employees of the firm. Provide home address, telephone number, education, training, and employment with dates and specific duties with the company
- ☐ 2 Proof of ethnicity for each person with ownership interest (valid passport, ethnic birth certificate)*
- ☐ 3 Proof of U.S. Citizenship (valid U.S. passport, ethnic birth certificate, naturalization certificate)*
- ☐ 4 Proof of permanent resident alien status (valid permanent resident alien "green" card showing expiration date)*
- ☐ 5 Bank signature card, bank resolution or letter from bank identifying persons authorized to conduct transactions on each account
- ☐ 6 Lease agreement or proof of ownership (deed/mortgage) for business location(s)
- ☐ 7 Proof of any certification (including SBA 8(a)), decertification, or denial from another governmental agency, department, or authority
- ☐ 8 Copies of any licenses, permits and/or accreditations required for conducting business
- ☐ 9 Proof of sources of capitalization/investments (purchase receipts, any loan agreements)
- ☐ 10 Any employment agreements
- ☐ 11 All third party agreements including: equipment rental, purchase agreements, management service agreements, etc.
- ☐ 12 Vehicle registration(s) for any vehicle used for business purposes
- ☐ 13 Current financial statement (statement of cash flows, balance sheet, or profit and loss statement)
- ☐ 14 Most recent three years' business Federal, State and City tax returns (all pages, all schedules); Prior two (2) years of personal tax returns (1040's) for each person with ownership interest, including all applicable W-2 forms and schedules if in business less than three years

If you have one document that satisfies the requirements for numbers 2 – 4, submit only one copy.

REQUIRED FOR A SOLE PROPRIETORSHIP

☐ Copy of Business Trade Name or Certification Trade Name filed with County Clerk (If doing business under an assumed name)

REQUIRED FOR A PARTNERSHIP AND JOINT VENTURE PARTNERSHIP

Attach copies of the following: (Indicate documents submitted by checking appropriate boxes)

☐ 1. Business Certificate

☐ 2. Partnership Agreement

REQUIRED FOR A LIMITED LIABILITY COMPANY (Check appropriate boxes below)

☐ 1. Sole Proprietorship

☐ 2. Corporation

☐ 3. Partnership Agreement

Attach required documents and indicate documents submitted by checking appropriate boxes

☐ 1. Certificate of formation and/or organization

☐ 2. Operating and/or managing agreements

☐ 3. Franchise and/or third-party agreement

REQUIRED FOR A CORPORATION

Attach documents of the following: (Indicate documents submitted by checking appropriate boxes)

☐ 1. Articles of incorporation, including date approved by State

☐ 2. Corporation By-Laws

☐ 3. Minutes of first corporate organizational meeting and amendments

☐ 4. Copies of all issued stock certificates front and back, as well as next un-issued certificate

☐ 5. Copy of stock ledger

☐ 6. If applicable, furnish copies of agreements relating to:

a. stock options
b. shareholder agreements
c. shareholder voting rights
d. restriction on the disposal of stock loan agreements
e. facts pertaining to the value of shares
f. buy-out rights
g. restrictions on the control of the corporation

SMALL BUSINESS ENTERPRISE PROGRAM
ADMINISTERED BY
THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

The Small Business Enterprise Programs are designed to promote New York and New Jersey businesses and to provide them with the advantage of competing against firms of like size and expertise in a limited competitive environment. In order to be eligible to participate in opportunities set-aside for the programs, the Port Authority must certify a firm as a Small Business Enterprise. To be eligible for certification, firms at a minimum:

- Must have a principal place of business in either New York or New Jersey.
- Must have operated that specific type of business for at least three (3) years.
- Must not exceed the average annualized gross revenue limitations cited below for the last three (3) fiscal years.

Average Annualized Gross Revenue Limitation and other Port Authority Pre-requisites by Procurement Category.

- **Construction - $14 million**
  The Port Authority's Engineering Department must also qualify construction firms. This requires the submittal of acceptable references for completed contracts. A minimum of three acceptable references is required for each construction specialty area.

- **Architectural & Engineering (A&E) - $4.5 million**
  - ***Landscape Architectural Services - $7 million***
  - ***Marine Engineering & Naval Architecture - $18.5 million***

  In addition to adhering to maximum gross revenues Thresholds, A&E firms must also have minimum average annual revenues of more than $100,000 over the last three (3) fiscal years.

- **Commodity - $7 million**
  Commodity firms eligible to participate are provided a five percent (5%) price preference in designated contracts solicited by the Port Authority's Procurement Division.

- **Janitorial Maintenance - $16.5 million**

- **Unarmed Guard Service - $18.5 million**

- **Financial Services - $7 million**

INFORMATION FOR DETERMINING JOINT VENTURE ELIGIBILITY

Return your submittal to:	*The Port Authority of NY & NJ* *Office of Business and Job Opportunity* *233 Park Avenue South, 4th Floor* *New York, NY 10003*
	Firms not currently certified should call (212) 435-7808 for information

**(NOTE: This form need not be completed if all joint venture firms are *M/W/DBEs*
The Joint Venture approval is valid through the duration of the Port Authority contract)**

1. NAME OF JOINT VENTURE: _____

2. ADDRESS OF JOINT VENTURE: _____

_____

_____

3. TELEPHONE NUMBER (S) OF JOINT VENTURE: _____

_____

4. (A) IDENTIFY THE FIRMS WHICH COMPRISE THE JOINT VENTURE. (THE MINORITY OR WOMAN-OWNED OR DISADVANTAGED BUSINESS ENTERPRISE PARTNER MUST COMPLET A UNIFORM CERTIFICATION APPLICATION – SCHEDULE A)

_____

_____

(B) DESCRIBE THE ROLE OF THE M/W/DBE IN THE JOINT VENTURE:

_____

_____

_____

5. NATURE OF THE JOINT VENTURE'S BUSINESS: _____

_____

_____

6. PROVIDE A COPY OF THE JOINT VENTURE AGREEMENT.

SCHEDULE B

7. WHAT IS THE CLAIMED PERCENTAGE OF MBE OR WBE OF DBE OWNERSHIP? _____

8. OWNERSHIP OF JOINT VENTURE: (THIS NEED NOT BE FILLED IN IF DESCRIBED IN THE JOINT VENTURE AGREEMENT)

(A) PROFIT AND LOSS SHARING: _____

_____

(B) CAPITAL CONTRIBUTIONS, INCLUDING EQUIPMENT:

_____

_____

_____

(C) OTHER APPLICABLE OWNERSHIP INTERESTS:

_____

_____

_____

9. CONTROL OF AND PARTICIPATION IN THIS CONTRACT. IDENTIFY BY NAME, RACE, SEX AND "FIRM" THOSE INDIVIDUALS AND THEIR TITLES WHO ARE RESPONSIBLE FOR DAY-TO-DAY MANAGEMENT AND POLICY DECISION-MAKING, BUT NOT LIMITED TO, THOSE WITH PRIME RESPONSIBILITY FOR:

NAME & TITLE	SEX		GROUP CODE*	FIRM
FINANCIAL DECISIONS				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____
MANAGEMENT DECISIONS, SUCH AS:				
ESTIMATING				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____
MARKETING AND SALES				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

HIRING AND FIRING OF MANAGEMENT PERSONNEL

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

PURCHASING OF MAJOR ITEMS OR SUPPLIES

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

SUPERVISION OF FIELD OPERATIONS

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

***GROUP CODE KEY**

01 – BLACK	02A – HISPANIC	03A – ASIAN-PACIFIC	04 – NATIVE AMERICAN
	02B – PORTUGUESE	03B – ASIAN-INDIAN	05 – NON-MINORITY
	02C – SPANISH		06 - OTHER

Affidavit

"The undersigned swear that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operation of the joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned agree to provide to the grantee current and complete information and any proposed changes to the joint venture arrangement. The undersigned also agree to permit authorized representatives of the grantee or the Federal-funding agency to audit and examine the books, records and files of the joint venture, or those of each joint venturer relevant to the joint venture. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statement."

NAME OF FIRM	NAME OF FIRM
SIGNATURE	SIGNATURE
NAME	NAME
TITLE	TITLE
DATE	DATE

State of _____ County of _____

On this _____ day of _____, 20____, before me appeared (name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

_____
Notary Public

State of _____ County of _____

On this _____ day of _____, 20____, before me appeared (name) _____ to me personally known, who being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

_____
Notary Public

THE PORT AUTHORITY OF NY & NJ

Office of Business and Job Opportunity

PAGE _____ OF _____

NOTE: The Contractor is required to submit to the Engineering Dept. a MODIFIED PLAN for any changes to the original plan: i.e.; subcontractor, dollar amount or work performed.
If more than 1 page is used, complete totals on last page.

Contract Number: _____ **Contract Description:** _____

Contractor Name: _____

Mailing Address: _____ **Contract Amount:** _____

Telephone Number: _____ **Contract Goals:** **MBE** _____ **WBE** _____ **DBE** _____

Name, Address, Phone Number of PA Certified MBE/WBE/DBE subcontractor (including name of contact person)	Indicate MBE, WBE Or DBE	Description of Work, Services to be provided. Where applicable, specify, "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	*Approximate $ amount of M/W/DBE Subcontract	MBE/WBE/DBE % of Total Contract Amount
			TOTAL:		

Signature of Contractor: _____

Print Name: _____

Title: _____ Date _____

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by: _____
OBJO Business Development Representative
Print Name: _____ Date _____

Distribution: Original – OBJO; Copy 2 – Engineer of Construction; Copy 3 – Contractor; Copy 4 – Line Department
*Please Note: supplies, equipment and material men are only credited 60% towards the M/W/DBE goal. Please adjust calculations accordingly.

Schedule C

2773

INSTRUCTIONS

CONTRACTOR INSTRUCTIONS: Contractor is required to submit a MBE/WBE Participation Plan and/or best efforts documentation to the designee identified in the contract book within 7 days after the opening of the Proposals for this Contract.

ENGINEER OF CONSTRUCTION INSTRUCTIONS: After the review of the submitted MBE/WBE Participation plan, forward to the Office of Business and Job Opportunity via fax at (212) 435-7828 or PAD to 233 PAS 4th Floor for review and approval. Approved/waived/rejected plan will be returned within 10 business days of receipt of this document. Engineer of Construction will advise vendor of the results of the MBE/WBE Participation Plan review.

PA 3749 A/ 5-07

THE PORT AUTHORITY OF NY & NJ
Office of Business and Job Opportunity

CONSTRUCTION
MBE/WBE/DBE PARTICIPATION PLAN
MODIFIED

PAGE _____ OF _____

Contract Number: _____

Contractor Name: _____

Mailing Address: _____

Telephone Number: _____

Contract Description: _____

Contract Amount: _____

Contract Goals: **MBE** _____ **WBE** _____ **DBE** _____

Name, Address, Phone Number of PA Certified MBE/WBE/DBE subcontractor (including name of contact person)	Indicate MBE, WBE Or DBE	Description of Work, Services to be provided. Where applicable, specify "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	*Approximate $ amount of M/W/DBE Subcontract	MBE/WBE/DBE % of Total Contract Amount
			TOTAL:		

Signature of Contractor: _____

Print Name: _____

Title: _____ Date _____

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by: _____
OBJO Business Development Representative
Print Name: _____ Date _____

Distribution: Original – OBJO; Copy 2 – Engineer of Construction; Copy 3 – Contractor; Copy 4 – Line Department
*Please Note: supplies, equipment and material men are only credited 60% towards the M/W/DBE goal. Please adjust calculations accordingly.

Schedule C

STATEMENT OF PAYMENTS TO M/W/DBE SUBCONTRACTORS/LESSORS/SUPPLIERS

Contract No: _____ Period Reporting: _____ (Example: 10/1/99 - 10/31/99)

Contract Title: _____ Payment Appl #: _____

Contractor: _____ % Project Completed: _____

SUBCONTRACTOR'S NAME	(Indicate) MBE WBE DBE	ESTIMATED TOTAL SUBCONTRACT AMOUNT	Column A AMOUNTS PAID Prior Statement	+ Column B This Statement	= Column C Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0

SUPPLIERS/LESSORS	(Indicate) MBE WBE DBE	TOTAL AMOUNT SUPPLIER AGREEMENT	AMOUNTS PAID (Amounts entered should reflect 100% paid. The 50% credit will be handled by the office.) Prior Statement	This Statement	Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0

Date Prepared: _____

Prepared by: _____

Title: _____

Officer's Signature: _____

The Port Authority of NY & NJ
Resident Engineer's Office

Date Received: _____

Reviewed By: _____

Title: _____

Schedule D

FINAL

STATEMENT OF PAYMENT
TO M/W/DBE SUBCONTRACTORS/LESSORS/SUPPLIERS

Contract No:		Period Reporting:	(Example: 10/1/98 - 10/31/98)
Contract Title:		Payment Appl #:	& Final
Contractor:		% Project Completed:	100%

SUBCONTRACTOR'S NAME	(Indicate) MBE WBE DBE	TOTAL SUBCONTRACT AMOUNT	Column A AMOUNTS PAID & TO BE PAID: Prior Statement	+ Column B This Statement	= Column C Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0

SUPPLIERS/LESSORS	(Indicate) MBE WBE DBE	TOTAL AMOUNT SUPPLIER AGREEMENT	AMOUNTS PAID & TO BE PAID (Amounts entered should reflect 100% paid. The 40% credit will be handled by the office.) Prior Statement	This Statement	Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0

Date Prepared:	For The Port Authority of NY & NJ Resident Engineer's Office
Prepared by:	
Title:	Date Received:
Officer's Signature:	Reviewed By:
	Title:

Schedule D

ANALYSIS OF BID

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

THIS IS NOT PART OF CONTRACT

BID DATE
SHEET
CONTRACTOR
CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
1	General Conditions		LS		
2	Self Launching Gantry System		LS		
3	Maintenance of Traffic		LS		
4	Civil Works				
5	Excavation and Disposal		CY		
6	Granular And Structural Backfill		CY		
7	Asphalt Concrete Pavement		TON		
8	Portland Cement Concrete Pavement		CY		
9	Mechanically Stabilized Earth Retaining Wall including Moment Slab and Leveling Pad		SF		
10	Reinforced Concrete Pipes		LS		
11	Ductile Iron Pipes		LS		
12	RCP Box Detention Structure		LF		
13	Catch Basins and Manholes		LS		
14	Chain Link Fence And Arch Abutment Fence with Gates		LF		
15	All Remaining Civil Works		LS		
16	Structural Works				
17	Demolition Of Existing Toll Plaza		LS		
18	Demolition Of Existing Pier and Abutments		CY		
19	Demolition Of Existing Superstructure		CY		

ANALYSIS OF BID

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

THIS IS NOT PART OF CONTRACT

BID DATE
SHEET
CONTRACTOR
CONTRACT NO. AKB-264.039

Unit No.	Descriptions (1)	Quantity	Unit (2)	Unit Price	Amount
20	Demolition Of Existing Approach Deck		CY		
21	Demolition Of Existing Arch Floor Deck		SF		
22	Demolition Of Existing Redundancy Girders on Arch		TON		
23	Demolition Of Existing Sidewalk		SF		
24	Reinforced Concrete For Temporary Deck		CY		
25	Temporary Structural Support For Existing Substructure And Superstructure		LS		
26	Temporary Suspenders		EA		
27	Temporary Scuppers and Drainage Pipes		LS		
28	Cofferdams		LS		
29	Concrete For Footings, Abutments, Substructure And Superstructure		CY		
30	Light Weight Concrete Deck For Arch Structure		CY		
31	Epoxy Coated Reinforcing Rebar For Footings, Abutments, Substructure And Superstructure		TON		
32	Stainless Steel Rebar For Superstructure And Arch Deck		TON		
33	Precast Concrete For Substructure		CY		
34	Post Tensioning Steel For Substructure		TON		
35	Precast Concrete For Superstructure		CY		
36	Post Tensioning For Superstructure		TON		
37	Grout For Post Tensioning And Supplemental Plates		CY		
38	Structural Steel For Towers		TON		

ANALYSIS OF BID

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

THIS IS NOT PART OF CONTRACT

BID DATE
SHEET
CONTRACTOR
CONTRACT NO. AKB-264.039

Unit No.	Descriptions (1)	Quantity	Unit (2)	Unit Price	Amount
39	Structural Steel For New Arch Members		TON		
40	Structural Steel For Lattice Members		TON		
41	Structural Steel For Cheese Plates		TON		
42	Structural Steel For Edge Girders		TON		
43	Structural Steel For Floor Beams		TON		
44	Structural Steel For Stringers		TON		
45	Structural Steel For Diaphragm And Lateral Bracing		TON		
46	Structural Steel For Blast Plates		TON		
47	Structural Steel Framing For Catwalk And Shared Use Path		TON		
48	Structural Steel Repair For Lattice and Cheese Plates		TON		
49	Remove And Replace Lower Chord Suspender Anchorage		TON		
50	Pier Bearings on Approach Structures		EA		
51	Expansion Joints on Approach Structures and Arch Structure		LS		
52	Railing For Shared Use Path		LF		
53	Railing For Parapet and Catwalk		LF		
54	Catwalk Grating		SF		
55	Structural Work Related To Administration Building, MEP Buildings, Tower Buildings and Storage Buildings		LS		
56	All Remaining Structural Works		LS		
57	Architectural Work		LS		

ANALYSIS OF BID

THE PORT AUTHORITY OF NY & NJ

PROJECT Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures

BID DATE

SHEET

THIS IS NOT PART OF CONTRACT

CONTRACTOR

CONTRACT NO. AKB-264.039

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
58	Mechanical and Plumbing Works		LS		
59	Fire Protection Work		LS		
60	Electrical Works				
61	4" and 3" PVC Coated Rigid Galvanized Steel Conduit		LS		
62	4" Rigid Galvanized Steel Conduit		LF		
63	3" Rigid Galvanized Steel Conduit		LF		
64	1/C #500 and #600 Kcmil XHHW		LS		
65	Roadway and Bridge Lighting Works		LS		
66	Temporary Staging And Maintenance Of Power Distribution		LS		
67	Electrical Work Related To Administration Building, MEP Buildings, Tower Buildings and Storage Buildings		LS		
68	All Remaining Electrical Works		LS		
69	Electronics Work				
70	Temporary Work		LS		
71	4" PVC Coated Rigid Galvanized Steel Conduit		LF		
72	All Remaining Electronics Conduit And Wiring		LS		
73	All Work Related to AT&T and Verizon		LS		
74	All Remaining Electronics Work		LS		
75	SCADA System		LS		
76	Temporary and Permanent Gantry System including Framing and Toll Equipment		LS		

ANALYSIS OF BID

THE PORT AUTHORITY OF NY & NJ

PROJECT **Bayonne Bridge - Replacement of Main Span Roadway And Approach Structures**

BID DATE _____

THIS IS NOT PART OF CONTRACT

SHEET _____

CONTRACTOR _____

CONTRACT NO. **AKB-264.039**

Unit No.	Descriptions [1]	Quantity	Unit [2]	Unit Price	Amount
77	Environmental Work				
78	Lead Abatement, Abrasive Blast Cleaning and Repainting		SF		
79	Permanent Traffic				
80	F-Shaped Concrete Barrier		LF		
81	All Remaining Permanent Traffic Works		LS		
82	Intelligent Traffic System		LS		
	Total Lump Sum =				

1. Separate and list all items or operations of work included in your estimate in accordance with Specifications. When listing subcontracts, prime contractor will have each subcontractor complete an analysis of bid form.
2. Unit of measure, i.e., SF, CY, Bbls, Pcs, Ea., etc.
3. Include all charges, such as moving on site, removal, rental, etc.
4. In case of conflict between information hereon (whether supplied by Authority or the bidder) and terms or prices contained or inserted in Contract Booklet or Contract Drawings, said Booklet and Drawings shall control.
5. Analysis of Bid is not part of contract. No information hereon (whether supplied by Authority or the bidder) and no information deduced from information hereon, including quantities of materials or work, shall be deemed to vary, alter or modify any provision of Contract, including provisions rein as to compensation and performance. unit prices contained hereon serve sole purpose of informing Port Authority as to components of bidder's price quoted in Contract. items of materials or work contained hereon shall not deemed to be an exhaustive list of items of materials or work required by Contract Drawings and Specifications in their present form.